FREQUENTLY ASKED QUESTIONS

January 2002

9215FQ03B

Facilities & Buildings

Q1. When did IBM **first open its offices** in my town?

A1. While it is not possible for us to provide such information for each and every office facility throughout the world, the following listing provides the date IBM offices were established in more than 300 U.S. and international locations:

Adelaide, Australia	1914
Akron, Ohio	1917
Albany, New York	1919
Albuquerque, New Mexico	1940
Alexandria, Egypt	1934
Algiers, Algeria	1932
Altoona, Pennsylvania	1915
Amsterdam, Netherlands	1914
Anchorage, Alaska	1947
Ankara, Turkey	1935
Asheville, North Carolina	1946
Asuncion, Paraguay	1941
Athens, Greece	1935
Atlanta, Georgia	1914
Aurora, Illinois	1946
Austin, Texas	1937
Baghdad, Iraq	1947
Baltimore, Maryland	1915
Bangor, Maine	1946
Barcelona, Spain	1923
Barranquilla, Colombia	1946
Baton Rouge, Louisiana	1938
Beaumont, Texas	1946
Belgrade, Yugoslavia	1926
Belo Horizonte, Brazil	1934
Bergen, Norway	1946
Berlin, Germany	1914 (prior to)
Bethlehem, Pennsylvania	1938
Beyrouth, Lebanon	1947
Bilbao, Spain	1946
Birmingham, Alabama	1919
Birmingham, England	1930
Bogota, Colombia	1931
Boise, Idaho	1948
Bordeaux, France	1932

Boston, Massachusetts	1914
Brantford, Ontario	1947
Bremen, Germany	1938
Bridgeport, Connecticut	1919
Brisbane, Australia	1914
Brooklyn, New York	1915
Brussels, Belgium	1919
Bucharest, Rumania	1929
Budapest, Hungary	1914 (prior to)
Buenos Aires, Argentina	1914 (prior to)
Buffalo, New York	1915
Butte, Montana	1931
Cairo, Egypt	1947
Calcutta, India	1936
Calgary, Alberta	1922
Canton, Ohio	1921
Cape Town, South Africa	1933
Caracas, Venezuela	1937
Casablanca, Morocco	1932
Cedar Rapids, Iowa	1946
Charleston, South Carolina	1946
Charleston, West Virginia	1941
Charlotte, North Carolina	1920
Chatham, New Brunswick	1947
Chattanooga, Tennessee	1919
Cheyenne, Wyoming	1946
Chicago, Illinois	1914
Cincinnati, Ohio	1915
Ciudad Trujillo, Dominican Republic	1948
Cleveland, Ohio	1915
Columbia, South Carolina	1934
Columbus, Georgia	1946
Columbus, Ohio	1917
Concord, New Hampshire	1936
Copenhagen, Denmark	1914
Corpus Christi, Texas	1941
Dakar, West Africa	1946
Dallas, Texas	1915
Damascus, Syria	1947
Dayton, Ohio	1919
Denver, Colorado	1919
Des Moines, Iowa	1916
Detroit, Michigan	1915
Dortmund-Dorstfeld, Germany	1938
Dresden, Germany	1927

Dublin, Ireland	1946
Duluth, Minnesota	1919
Dusseldorf, Germany	1926
Edmonton, Alberta	1941
El Paso, Texas	1919
Elisabethville, Belgian Congo	1938
Elizabeth, New Jersey	1946
Elmira, New York	1945
Endicott, New York	1920
Erie, Pennsylvania	1920
Essen, Germany	1938
Evansville, Indiana	1945
Flint, Michigan	1936
Florence, Italy	1943
Fort Wayne, Indiana	1939
Fort Worth, Texas	1924
Fortaleza, Brazil	1948
Frankfurt-Main, Germany	1938
Fresno, California	1946
Galveston, Texas	1946
Geneva, Switzerland	1935
Glasgow, Scotland	1914 (prior to)
Goteborg, Sweden	1935
Grand Rapids, Michigan	1917
Green Bay, Wisconsin	1946
Greensboro, North Carolina	1920
Greenville, South Carolina	1946
Hagerstown, Maryland	1948
Halifax, Nova Scotia	1919
Hamburg, Germany	1925
Hamilton, Bermuda	1935
Hamilton, Ontario	1914 (prior to)
Hammond, Indiana	1946
Hannover, Germany	1938
Hanoi, French Indo-China	1935
Harrisburg, Pennsylvania	1919
Hartford, Connecticut	1915
Havana, Cuba	1927
Helena, Montana	1946
Helsinki, Finland	1923
Hobart, Australia	1914
Hong Kong	1948
Honolulu, Hawaii	1931
Houston, Texas	1915
Huntington, West Virginia	1919

Indianapolis, Indiana	1915
Jackson, Michigan	1946
Jackson, Mississippi	1938
Jacksonville, Florida	1919
Jamestown, New York	1941
Jeddah, Saudi Arabia	1947
Jefferson City, Missouri	1939
Jersey City, New Jersey	1939
Jerusalem, Palestine	1947
Johannesburg, South Africa	1938
Johnstown, Pennsylvania	1937
Joplin, Missouri	1947
Kalamazoo, Michigan	1940
Kansas City, Missouri	1915
Karlsruhe, Germany	1938
Kassel, Germany	1941
Kingsport, Tennessee	1946
Kingston, Ontario	1946
Kitchner, Ontario	1942
Knoxville, Tennessee	1934
Koln, Germany	1938
La Paz, Bolivia	1941
Lafayette, Indiana	1946
Lansing, Michigan	1920
Lille, France	1925
Lisbon, Portugal	1919
Long Beach, California	1946
Los Angeles, California	1916
Lawrence, Massachusetts	1939
Leeds, England	1930
Lexington, Kentucky	1948
Liege, Belgium	1945
Lima, Ohio	1946
Lima, Peru	1930
Lincoln, Nebraska	1936
Little Rock, Arkansas	1935
London, England	1914 (prior to)
London, Ontario	1920
Louisville, Kentucky	1919
Lubbock, Texas	1946
Macon, Georgia	1919
Madison, Wisconsin	1946
Madrid, Spain	1916
Malmoe, Sweden	1938
Manchester, England	1925

Manila, Philippines	1931
Marseille, France	1928
Medellin, Colombia	1940
Melbourne, Australia	1914
Memphis, Tennessee	1921
Mexico City, Mexico	1927
Miami, Florida	1940
Milan, Italy	1928
Milwaukee, Wisconsin	1915
Mineola, New York	1947
Minneapolis, Maryland	1915
Mobile, Alabama	1942
Moline, Illinois	1938
Moncton, New Brunswick	1946
Monterey, Mexico	1946
Montevideo, Uruguay	1923
Montgomery, Alabama	1939
Montpelier, Vermont	1946
Montreal, Quebec	1914 (prior to)
Mount Vernon, New York	1948
Munich, Germany	1930
Nancy, France	1937
Nantes, France	1935
Naples, Italy	1947
Nashville, Tennessee	1933
New Bedford, Massachusetts	1946
New Delhi, India	1947
New Haven, Connecticut	1929
New Orleans, Louisiana	1919
New York, New York	1914
Newark, New Jersey	1915
Newcastle-on-Tyne, England	1933
Niteroi, Brazil	1945
Norfolk, Virginia	1942
Nurnberg, Germany	1935
Oakland, California	1919
Olympia, Washington	1939
Omaha, Nebraska	1919
Orlando, Florida	1946
Oslo, Norway	1916
Ottawa, Ontario	1919
Panama City, Panama	1931
Paris, France	1914 (prior to)
Paterson, New Jersey	1946
Peoria, Illinois	1919

Perth, Australia	1914
Philadelphia, Pennsylvania	1914
Phoenix, Arizona	1940
Pierre, South Dakota	1946
Pittsburgh, Pennsylvania	1916
Porto Alegre, Brazil	1934
Poughkeepsie, New York	1924
Portland, Maine	1919
Portland, Oregon	1916
Prague, Czechoslovakia	1925
Providence, Rhode Island	1917
Quebec City, Quebec	1921
Quincy, Illinois	1946
Raleigh, North Carolina	1938
Reading, Pennsylvania	1921
Recife, Brazil	1948
Regina, Canada	1946
Richmond, Virginia	1917
Rio de Janeiro, Brazil	1921
Riverside, California	1947
Roanoke, Virginia	1921
Rochester, New York	1915
Rockford, Illinois	1921
Rome, Italy	1930
Saarbrucken, Germany	1935
Sacramento, California	1921
Saigon, French Indo-China	1938
St. Louis, Missouri	1915
Salem, Oregon	1947
Salt Lake City, Utah	1919
San Antonio, Texas	1921
San Diego, California	1939
San Francisco, California	1914
San Jose, California	1940
San Jose, Costa Rica	1944
San Juan, Puerto Rico	1918
Santiago, Chile	1924
Sao Paulo, Brazil	1934
Sao Salvador, Brazil	1941
Savannah, Georgia	1919
Schenectady, New York	1946
Scranton, Pennsylvania	1916
Seattle, Washington	1915
Shanghai, China	1928
Shreveport, Louisiana	1944

Sioux City, Iowa	1921
Sofia, Bulgaria	1926
South Bend, Indiana	1917
Spokane, Washington	1919
Springfield, Illinois	1937
Springfield, Massachusetts	1917
Springfield, Missouri	1946
Springfield, Ohio	1946
Stockholm, Sweden	1920
Stockton, California	1946
Strasbourg, France	1930
Stuttgart, Germany	1926
Sydney, Australia	1914 (prior to)
Syracuse, New York	1916
Tacoma, Washington	1946
Tallahassee, Florida	1938
Tampa, Florida	1946
Teheran, Iran	1947
Three Rivers, Quebec	1947
Toledo, Ohio	1919
Toulouse, France	1940
Topeka, Kansas	1936
Toronto, Ontario	1914 (prior to)
Trenton, New Jersey	1934
Tulsa, Oklahoma	1928
Tunis, Tunisia	1946
Turin, Italy	1914 (prior to)
Utica, New York	1921
Vancouver, British Columbia	1914 (prior to)
Venice, Italy	1948
Vienna, Austria	1914 (prior to)
Waco, Texas	1946
Warren, Ohio	1947
Washington, D.C.	1915
Waterbury, Connecticut	1935
Waterloo, Iowa	1947
Wellington, New Zealand	1947
Wheeling, West Virginia	1921
Wichita, Kansas	1924
Wilmington, Delaware	1938
Windsor, Ontario	1939
Winnipeg, Manitoba	1917
Winston-Salem, North Carolina	1937
Worcester, Massachusetts	1917
York, Pennsylvania	1936

Youngstown, Ohio	1919
Zurich, Switzerland	1914 (prior to)

Q2. In what year did IBM **open** its various **manufacturing and laboratory facilities** in the United States?

A2. The following list provides the year in which certain IBM U.S. facilities first became operational:

Austin (Texas) plant	1966
Boca Raton (Fla.) plant	1967
Boulder (Colo.) plant	1965
Brooklyn (N.Y.) plant	1968
Burlington (Vt.) plant	1957
Dayton (N.J.) laboratory	1967
Dayton (N.J.) plant	1958
Charlotte (N.C.) plant	1978
East Fishkill (N.Y.) plant	1963
Endicott (N.Y.) laboratory	
North Street	1933 (dedicated in December 1934)
Glendale Lab	1954
Endicott (N.Y.) plant	1906
Gaithersburg (Md.)	1966
Houston (Texas) [FSD NASA support]	1962
Kingston (N.Y.) plant	1956
Lexington (Ky.) plant	1956
Manassas (Va.) plant	1968
Menlo Park (Calif.) plant	1966
Owego (N.Y.) plant	1957 (dedicated in 1958)
Poughkeepsie (N.Y.) plant	1941
Raleigh (N.C.) plant	1965
Rochester (Minn.) plant	1956
San Jose (Calif.) card plant	1943
Santa Teresa (Calif.) laboratory	1977
Tucson (Ariz.) plant	1980
Yorktown (N.Y.) laboratory	1960 (dedicated in April 1961)

General Reference

Q1. I have an old IBM **clock** or **typewriter**. Can you tell me how much it is worth?

A1. While we appreciate your interest in one of IBM's old products, we regret that our staff is unable to provide appraisals of those products to determine their current worth. We suggest that you consult a local dealer — especially one specializing in the restoration and sale of old time pieces or office equipment — as well as classified ads for similar items. In addition, you might want to research prices on such online services as eBay. We may, however, be able to give you some general background information on the type of IBM product that you own if you send an online request to us.

Q2. What is the origin of IBM's "**THINK**" motto?

A2. In December 1911, when future IBM Chairman Thomas J. Watson, Sr., managed the sales and advertising departments of the National Cash Register Company, he is reported to have said at a sales meeting: "The trouble with everyone of us is that we don't think enough. We don't get paid for working with our feet; we get paid for working with our heads. … Thought has been the father of every advance since time began. … 'I didn't think' has cost the world millions of dollars." And he wrote "T-H-I-N-K" with a blue crayon on the easel behind him. Almost immediately, the one-word slogan had been placed on signs in every department at NCR. And Watson brought that concept with him when he later joined the Computing-Tabulating-Recording Company (C-T-R) — the forerunner of today's IBM — as general manager in 1914.

"THINK" appeared in C-T-R in the form of a large block-letter sign, famed and placed in offices and plants, and was printed in company publications. In the early 1930s — thanks to the process of plastic lamination which facilitated large-scale production and distribution — the THINK motto began to take precedence over other slogans in IBM. It soon appeared in wood, stone and bronze, and was published in company newspapers, magazines, calendars, photographs, medallions — even *New Yorker* cartoons — and it remains today the name of IBM's employee publication.

Q3. What is the history of the **IBM Corporate Archives**?

A3. The origins of the IBM Archives can be traced back to 1958 with the establishment of IBM's Corporate Records Retention Program. Six years later, a corporate archivist was hired to begin to pull together the company's historical records which were then spread throughout IBM's far-flung facilities. (Among the more intriguing company papers that had been preserved over the years was a copy of an agreement between Herman Hollerith, inventor and general manager of the Tabulating Machine Company — a forerunner of IBM — and the Imperial Russian Government. The agreement, dated Dec. 15, 1896, was for the purchase by the Czarist government of 35 electrical tabulating machines at a price of $1,700 each.)

In 1965, IBM's Records Center was moved from New York City to Hawthorne, N.Y., and, following that move, Archives materials were stored separately. The facility moved again in 1970 to Nyack, N.Y.

The Archives became a permanent corporate department in March 1974, and returned to Hawthorne the following year. At that time, the Archives was maintaining over 200,000 photographs, some 3,000 cans of motion picture film and 4,000 cubic feet of printed matter that traced IBM's development over the years.

In November 1979, the Corporate Archives was relocated to the IBM Management Development Center near the company's headquarters in Armonk, N.Y. In just the first five years of its formal existence, the Archives had already accumulated one of the world's finest historical collections on the punched-card era and the computer age which followed. It had preserved the office correspondence files and other business papers of Thomas J. Watson, Sr., from his early days as general manager and president of C-T-R in 1915 until his death in 1956, along with a wealth of printed and filmed material covering the origins and growth of what is now the information technology industry. These materials were then housed in more than 8,000 boxes, and included more than 4,300 phonograph records made of aluminum, glass and acetate; more than a quarter million photographs and negatives of individuals and products; more than 100,000 images on microfilm; and more than 1,000 post-1952 special events recorded on magnetic tape.

The Corporate Archives was relocated in 1994 into its current home in Somers, N.Y. It now constitutes one of the largest corporate archives in North America, with more than 10,000 shelf feet of documents and publications, 5,000 film and video titles, and an artifacts collection dating back to the 1600s.

The photographs and negatives provide visual records of executives, buildings and sites, products, Hundred Percent Clubs, Tent City meetings, education classes and other special events dating back to 1890. Product photos include early weight scales of the familiar type used in groceries and other stores, time stamps, attendance time recorders and punched-card machines. Among copies of pre-1920 company publications are *The Early Bird* and *The Tabulator*. *Business Machines*, for many years IBM's sole internal publication, is preserved in bound volumes, along with *Think* and the different editions of *The IBM News*. Also preserved in the Archives are motion pictures of special events, oral histories, technical disclosure bulletins, financial ledgers, press releases, product brochures, advertisements, patents and engineering documents.

Q4. What were the key events and developments in the **early days of IBM**? What kind of products did it sell? Where did it operate?

A4. Following the creation of the Computing-Tabulating-Recording Company (C-T-R) — the forerunner of IBM — in 1911 and the subsequent hiring of Thomas J. Watson, Sr., as its general manager in 1914, the first important development was the creation of International Business Machines Company, Ltd., of Canada on November 29, 1917, to consolidate the Canadian business of the three original C-T-R components: the Computing Scale Company of America, the International Time Recording Company and the Tabulating Machine Company. That same year,

C-T-R took over the American Automatic Scale Company of Chicago, a manufacturer of automatic heavy capacity weighing devices. It was renamed the International Scale Company and later became a division of IBM for conducting its industrial scales business.

In the years following World War I, C-T-R's engineering and research staff developed new and improved mechanisms to meet the broadening needs of its customers. In 1919, for example, the company's implementation of electric synchronization for the control and regulation of complete time and programming systems began to win commercial success. In 1920, IBM introduced the lock autograph recorder, the first complete school time-control system, and launched the Electric Accounting Machine. In 1921, the company acquired the business of the Ticketograph Company of Chicago, and certain patents and other property of the Peirce Accounting Machine Company.

The growth and extension of C-T-R's activities had made the old name of the company too limited, and, on February 14, 1924, C-T-R's name was formally changed to International Business Machines Corporation. By then, the company's business had expanded both geographically and functionally.

For example, the plant of the German company was completed in 1924 and began operations, and a company was organized that same year to carry on IBM's business in France. In 1929, Compania Internacional de Maquinas Comerciales S.A. was organized as the operating company for Mexico. In 1931 the first permanent installation of the Filene-Finlay Translator was set up in the Hall of the League of Nations at Geneva.

Thomas Watson, then IBM's President, created a major division in 1932 to lead the engineering, research and development efforts for the entire IBM product line. The following year, IBM completed one of the finest modern R&D laboratories in the world at Endicott, N.Y. Similarly, the IBM Schoolhouse was also completed at Endicott in 1933 to provide education and training for company employees. That same year saw the addition of an entirely new product division — the Electric Writing Machine Division — to the IBM organization

In 1934, IBM sold the retail scale business of its Dayton Scale Division to the Hobart Manufacturing Company, enabling IBM to focus on the industrial customers of its International Scale Division. Also in 1934, IBM opened a new factory in Berlin, and in 1935, established another new plant in Milan, Italy.

In 1935, IBM launched a new line of business with the introduction of the International Proof Machine. This single distribution tabulator was, in effect, 24 adding machines synchronized with a similar number of sorting receptacles and was controlled from two master keyboards. Originally designed to facilitate and control the clearing of checks in banks, the International Proof Machine later found new applications in other commercial and industrial accounting systems permitting vouchers, invoices and other commercial papers to be proved and distributed with amazing speed and accuracy.

IBM contributed to the field of education in 1937 with the announcement of the Test Scoring Machine which scored a complete examination in less time than it took to record the grade, and with far greater accuracy than a manual scorer.

Year after year, IBM produced constant improvements in electric accounting machines, including the development of automatic reproducing punches, summary card punches, multiplying punches, direct subtraction and accounting machines, and alphabetical equipment. The latter machines were capable of transcribing descriptive data in alphabetical form as well as the customary numerical total printing or detail listing.

During the little more than two decades after Thomas Watson had assumed the reins, IBM had grown from a $4 million business to a worldwide enterprise employing some 10,000 people, with more than $25 million in revenue. In the late-1930s, the company already owned and operated, directly or through subsidiaries, factories in ten cities in six countries (its principal plant at Endicott, N.Y.; a card-printing plant in Washington, D.C.; the Electric Writing Machine Factory at Rochester, N.Y.; and plants at Dayton, Ohio; Toronto, Canada; Hammersmith, near London, England; Berlin and Sindelfingen, Germany; Vincennes, near Paris, France; and Milan, Italy). IBM's World Headquarters Building, at 590 Madison Avenue in New York City opened on January 18, 1938, and fittingly was dedicated to "world peace through world trade." And even with all that business expansion and spreading international presence, the greatest period of IBM's growth still lie ahead.

Q5. What is the origin of the term "**wild ducks**" in IBM history and culture?

A5. Your question is best answered by the words of former IBM Chairman Thomas J. Watson, Jr., in his book, *A Business And Its Beliefs: The Ideas That Helped Build IBM*, published by McGraw-Hill in 1963:

> In IBM we frequently refer to our need for "wild ducks." The moral is drawn from a story by the Danish philosopher, Soren Kierkegaard. He told of a man on the coast of Zealand who liked to watch the wild ducks fly south in great flocks each fall. Out of charity, he took to putting feed for them in a nearby pond. After a while some of the ducks no longer bothered to fly south; they wintered in Denmark on what he fed them.
>
> In time they flew less and less. When the wild ducks returned, the others would circle up to greet them but then head back to their feeding grounds on the pond. After three or four years they grew so lazy and fat that they found difficulty in flying at all.
>
> Kierkegaard drew his point — you can make wild ducks tame, but you can never make tame ducks wild again. One might also add that the duck who is tamed will never go anywhere any more.
>
> We are convinced that any business needs its wild ducks. And in IBM we try not to tame them.

Human Resources

Q1. Who was IBM's **first woman senior executive**?

A1. Ruth M. Leach was selected as a IBM vice president in 1943 at the age of 27, and as such was one of the first women to hold an executive position in any company and the first ever to hold a corporate office with IBM. Her association with IBM began in 1939 when she worked as a demonstrator at the company's Gallery of Science and Art at the Golden Gate International Exposition in San Francisco. At the close of the fair, she attended Systems Service Class 448, and on graduation was assigned to the Atlanta office as a systems service representative. In 1940, Leach was promoted to the post of instructor with the Department of Education at Endicott, N.Y., and in October 1941, she was elevated to the position of secretary of education for women. She subsequently was named manager of the IBM Systems Service Department and in November 1943 was elected a vice president by the Board of Directors. During her business career, Leach received widespread recognition in the press and won many honors, including selection as one of the outstanding women of the year in 1945.

Legal

Q1. What can you tell me about the 1969 U.S. Department of Justice **antitrust lawsuit** against IBM?

A1. The background for the case of *United States of America v. International Business Machines Corporation* was laid two years before it began. In 1967, the U.S. Justice Department started an investigation of the data processing industry. Given IBM's prominence, it was clear that the company would become a focal point. But IBM and its lawyers also believed that, once an objective evaluation had been made, the Department could not help but conclude that the industry was, in fact, competitive. IBM lawyers met voluntarily with Department officials throughout 1967 and 1968, producing some 15,000 pages of file documents. But despite evidence to the contrary, the Department devised a unique, narrow definition of the market that was to become the basis of its case — and, in IBM's view, one of its major weaknesses. The Justice Department reckoned that IBM had only a handful of competitors.

By December 1968, signals from Washington indicated that the Department did, indeed, intend to file charges against IBM. With the impending change in Administrations, time was running out, and so Attorney General Ramsey Clark filed the suit on his last day on the job.

The complaint alleging violation of Section 2 of the Sherman Act — which makes it illegal to "monopolize or to attempt to monopolize . . . trade or commerce . . ." — filled just 12 double-spaced pages. Yet, as the decade and the case ground along, it would become what former U.S. Solicitor General Robert Bork called "the Antitrust Division's Vietnam."

The suit was filed in the Federal District Court for the Southern District of New York. But for almost three years, the Government did nothing to either prosecute the case or discuss a settlement. In 1970, IBM began providing documents to the Department as part of the pretrial discovery process that enables each side involved in litigation to get the facts to try the case. But within weeks, Department lawyers cut short their review of documents. They would rely, instead, on documents from the Control Data Corporation's private antitrust action against IBM. Filed in 1968, the CDC suit was settled and never went to trial.

Finally, in January 1972, David N. Edelstein, then Chief Judge of the Court, decided to preside over the case. To expedite the lawsuit, in October 1972, IBM asked that a separate, prompt trial be held on the critical issue of market definition. The Justice Department objected and was upheld. Trial dates were set and broken. In all, six years and four months had gone by before the trial could even begin at 10:30 a.m., May 19, 1975.

The Government took three years to present its case — almost eight times what it had predicted. It called 52 witnesses, offered more than 3,200 exhibits and filled nearly 72,000 pages of transcript. Along the way, it was allowed to introduce new definitions of "relevant market," scrapping the one it had argued for almost nine years. In midstream, the market IBM allegedly tried to monopolize assumed as many as five different definitions for five different time periods. The shift in ground led to an IBM motion for a mistrial on December 20, 1977. It was denied.

Within hours after the Government rested its case on April 26, 1978, IBM had its first witness on the stand.

As might be expected, IBM Chairman Frank T. Cary was to have been a key witness. But his testimony would hold no surprises. He had already been questioned for 35 days in depositions and three days on the stand in other trials. Some 300,000 pages of documents had been produced from his files. But, with the judge's consent, Cary was subpoenaed anyway and presented with new demands. The new material now requested would have called for the production of some five billion pages of material from 2,000 locations throughout the world, entailing almost 62,00 man-years of effort at a cost to IBM of more than $1 billion. In the end, the subpoena was withdrawn when IBM agreed that Cary's testimony would deal only with pre-1974 matters and be limited to a selection of excepts from his depositions and testimony in other trials, and he was deposed for another ten days.

Soon after Judge Edelstein had ordered IBM to comply with the subpoena, in July 1979, IBM asked the judge to remove himself from the case because of bias and prejudice against the company. Judge Edelstein refused, and in November 1979, the Court of Appeals denied an IBM petition. But the appeals panel that denied the petition also urged some kind of settlement.

Discussions to narrow the issues had begun in late 1979 but no agreement was reached before the change of Administration in January 1981. Both sides rested their cases on June 1 and were given until September 1 to submit proposed findings of fact, a customary procedure at the close of a trial.

And then, on January 8, 1982, the following stipulation was signed by Thomas D. Barr of Cravath, Swaine & Moore, for IBM, and by William F. Baxter, Assistant Attorney General, Antitrust Division, U.S. Department of Justice, for the United States of America:

> *Whereas*, the Assistant Attorney General in charge of the Antitrust Division and his staff undertook a review of this case in June 1981; and
>
> *Whereas*, that review has included a study of the trial record and a series of meetings with counsel wherein each of the issues of the case was presented in writing and orally and discussed and analyzed at length; and
>
> *Whereas*, that review has now been completed; and
>
> *Whereas*, plaintiff has concluded that the case is without merit and should be dismissed and has so informed the defendant
>
> *It is hereby stipulated and agreed* that this case is dismissed without costs to either side.

Thus ended — nine days short of 13 years, with more than 2,500 depositions and 66 million pages of documents — the longest antitrust trial in history. In Armonk, N.Y., IBM CEO John R. Opel greeted the dropping of the case as "wonderful news." He said that the Justice Department and many Federal courts had confirmed what "we have contended from the start: Our industry is healthy and competitive, and IBM has not violated the antitrust laws. This case has been burdensome for everyone and especially for our company. While we have never doubted its

ultimate outcome, we are happy it will not have to drag on through the courts for many more years."

Marketing

Q1. Did Thomas **Watson** say in the 1950s that he foresaw a market potential for **only five electronic computers**?

A1. We believe the statement that you attribute to Thomas Watson is a misunderstanding of remarks he made at IBM's annual stockholders meeting on April 28, 1953. In referring specifically and only to the IBM 701 Electronic Data Processing Machine -- which had been introduced the year before as the company's first production computer designed for scientific calculations -- Thomas Watson, Jr., told stockholders that "IBM had developed a paper plan for such a machine and took this paper plan across the country to some 20 concerns that we thought could use such a machine. I would like to tell you that the machine rents for between $12,000 and $18,000 a month, so it was not the type of thing that could be sold from place to place. But, as a result of our trip, on which we expected to get orders for five machines, we came home with orders for 18."

Personal Names

Q1. Please tell me something about the people who have served as IBM's **chairman of the board**?

A1. IBM has been guided by eight chairmen of the board since its founding as the Computing-Tabulating-Recording Company (C-T-R) in 1911. Under their leadership over the years, IBM has grown from a $4 million business with some 1,200 employees to an $81 billion enterprise employing more than 290,000 men and women around the world. In chronological order, IBM's former and current chairmen are:

George W. Fairchild

Born in Oneonta, N.Y., in 1854, George W. Fairchild was previously a farm worker, master printer, newspaper publisher, businessman, investor and six-term Republican Congressman before becoming president and, later, chairman of the board of directors of the Computing-Tabulating-Recording Company, the forerunner of today's IBM.

Mr. Fairchild is considered one of the pioneers of the time recording industry. He joined the Bundy Manufacturing Company, a time clock manufacturer, as both an investor and director in 1896. In the immediate years thereafter, Bundy implemented a series of mergers, acquisitions and consolidations, including Mr. Fairchild's creation of the International Time Recording Company, of which he became president in 1900. In 1911, Charles R. Flint led the merger of the International Time Recording Company, Computing Scale Company and the Tabulating Machine Company to form the Computing-Tabulating-Recording Company (C-T-R). Mr. Fairchild became president of the new company.

While representing the 34th District of New York in Congress, Mr. Fairchild also served as Vice President of the International Peace Conference. He was chairman of IBM — which C-T-R had been renamed in February 1924 — at the time of his death in December of that year.

Thomas J. Watson

Thomas J. Watson was a pioneer in the development of accounting and computing equipment used today by business, government, science and industry. He built a worldwide industry during his 42 years at IBM.

Mr. Watson was born in Campbell, N.Y., February 17, 1874. His first job was at age 18 as a bookkeeper in Clarence Risley's Market in Painted Post, N.Y. Later he sold sewing machines and musical instruments before joining the National Cash Register Company as a salesman in Buffalo. He eventually worked his way up to general sales manager. Bent on inspiring the dispirited NCR sales force, Mr. Watson introduced the motto, "THINK," which later became a widely known symbol of IBM.

Mr. Watson joined IBM, then known as the Computing-Tabulating-Recording Co., as general manager in 1914. The following year he became president. During the early days of his leadership, Mr. Watson placed heavy emphasis on education, research and engineering to insure

the company's growth. He believed these three factors essential for improving the then-existing models of business machines and the development of new ones. He was recognized as one of the first leaders of industry to offer widespread benefits to employees, including medical expenses, insurance and a pension plan.

Throughout his life, Mr. Watson maintained a deep interest in international relations. He adopted for IBM the slogan, "World Peace Through World Trade," worked closely with the International Chamber of Commerce and in 1937 was elected its president. For many years Mr. Watson served as a trustee of Columbia University and Lafayette College. He was presented with honorary degrees by 27 colleges and universities in the United States and four abroad.

Mr. Watson was named chairman in September 1949. A month before his death on June 19, 1956, Mr. Watson handed over the reins of the company to his eldest son, Thomas J. Watson, Jr. Another son, Arthur K. Watson, served as president of IBM World Trade Corp., the company's international operations.

Thomas J. Watson, Jr.

Thomas J. Watson, Jr., was chairman and chief executive officer during IBM's most explosive period of growth. He led the company from the age of mechanical tabulators and typewriters into the computer era. During his leadership, IBM grew from a medium-sized business to one of the dozen largest industrial corporations in the world. When Mr. Watson became Chief Executive Officer in 1956, IBM employed 72,500 people and had a gross income of $892 million. When he stepped down in 1971, employees numbered more than 270,000 and gross revenue was $8.3 billion. *Fortune* magazine once called him "the greatest capitalist who ever lived."

Mr. Watson was born in Dayton, Ohio, in 1914. He earned a B.A. degree from Brown University in 1937 and joined IBM as a salesman in Manhattan in October of that year. Mr. Watson served for five years as a pilot in the U.S. Army Air Corps, and at the time of his discharge held the rating of Senior Pilot and the rank of Lieutenant Colonel. After completing his military service, he returned to his duties at IBM.

In January 1952 he was elected president of the company. In May 1956 Mr. Watson was made chief executive officer and he was elected chairman of the board in May 1961. Mr. Watson stepped down as chairman and CEO in 1971, a year after suffering a heart attack. He remained a member of IBM's board of directors until 1984, taking time out from 1979 to 1981 to serve as U.S. Ambassador to the Soviet Union.

Thomas J. Watson, Jr., died in Greenwich, Conn., on December 31, 1993, of complications following a stroke. He was 79.

T. Vincent Learson

A native of Boston, T. Vincent Learson was IBM's chairman and chief executive officer from June 1971 through January 1973.

Mr. Learson majored in mathematics at Harvard University. He graduated in 1935 and joined IBM the same year. Rising through the sales and marketing ranks, he became vice president in 1954, senior vice president in 1964 and president in 1966. He was also elected to the board of directors in 1966. Following his retirement, he remained a director through 1975, and from 1977 through 1983.

Mr. Learson served as chairman of the board of governors of the New York Insurance Exchange; chairman of the finance committee, Spencer Foundation; a member of The Business Council; an overseer of Harvard University; chairman of the trustees of Newton College; and as a Woodrow Wilson Fellow. From September 1975 to January 1977, he served as Ambassador at Large to the United Nations Law of the Sea Conference. He also served on the advisory committee on Law of the Sea.

T. Vincent Learson died November 4, 1996, at age 84.

Frank T. Cary

Frank T. Cary was IBM's chief executive officer from January 1973 through January 1981. He was chairman of the board from January 1973 through February 1983.

Born in Idaho and raised in Inglewood, Calif., Mr. Cary graduated from UCLA and received a master's degree in business administration from Stanford University.

Mr. Cary joined IBM in 1948 as a marketing representative in Los Angeles. He subsequently held a number of management positions and was named president of the Data Processing Division in 1964. In 1966, he was named vice president and group executive and general manager of the Data Processing Group. He became a senior vice president in 1967 and joined the board of directors the following year. In 1969 he joined the Corporate Office and became a member of the Management Review Committee. He was elected executive vice president and a member of the executive committee in March 1971 and president in June of the same year.

After stepping down as chairman and chief executive officer, Mr. Cary remained a director of the company until 1991.

John R. Opel

John R. Opel was IBM's chief executive officer from January 1981 through January 1985 and chairman of the board from February 1983 through May 1986.

Born in Kansas City, Mo., and raised in Jefferson City, Opel graduated from Westminster College in Fulton, Mo., and the University of Chicago, where he received a master's degree in business administration.

Mr. Opel joined IBM in 1949 as a sales representative in Jefferson City, and held various management posts. He became a vice president in 1966 and was appointed to the Management Committee the following year. He became vice president of corporate finance and planning in 1968, senior vice president in 1969 and group executive of the Data Processing Product Group in

January 1972. He was elected to the IBM board of directors later that year. In 1974 he was named president.

In January 1985, Mr. Opel was succeeded as president by John F. Akers. He remained as chairman until May 1986 and as a member of IBM's board of directors and chairman of its executive committee until 1993.

John F. Akers

John F. Akers became chief executive officer of IBM in February 1985. In June 1986, he assumed the additional position of chairman of the board. He retired from both positions on April 1, 1993, after 33 years of service to IBM.

A graduate of Yale University with a B.S. degree, Mr. Akers joined IBM in 1960 as a sales trainee in San Francisco following active duty as a Navy carrier pilot. After various marketing assignments, he was named president of the Data Processing Division, then IBM's largest domestic marketing unit, in 1974, at age 39. He became a vice president in 1976 and was named assistant group executive, plans and controls, Data Processing Marketing Group. He was appointed group executive of the Data Processing Marketing Group in 1978. In 1981 he became group executive, Information Systems and Communications Group.

Mr. Akers was elected a senior vice president in 1982 and IBM president and director in 1983. In 1984 he was elected chief executive officer effective February 1985.

Louis V. Gerstner, Jr.

Louis V. Gerstner, Jr., was named chairman and chief executive officer of IBM on April 1, 1993. Prior to joining IBM, Mr. Gerstner served for four years as chairman and chief executive officer of RJR Nabisco, Inc. This was preceded by an 11-year career at American Express Company, where he was president of the parent company and chairman and CEO of its largest subsidiary, American Express Travel Related Services Company. Prior to that, Mr. Gerstner was a director of the management consulting firm of McKinsey & Co., Inc., which he joined in 1965.

A native of Mineola, New York, Mr. Gerstner received a bachelor's degree in engineering from Dartmouth College in 1963 and an MBA from Harvard Business School in 1965. In 1994 he was awarded an honorary doctorate of business administration from Boston College, and in 1997 honorary doctorate of laws from both Wake Forest University and Brown University.

A lifetime advocate of the importance of quality education, Mr. Gerstner is co-author of *Reinventing Education: Entrepreneurship in America's Public Schools* (Dutton 1994).
He is vice chairman of the New American Schools Development Corporation and co-chairs Achieve, an organization created by U.S. Governors and business leaders to drive high academic standards for public schools in the United States. At IBM he has established Reinventing Education as the company's program in support of systemic school reform. Through Reinventing Education, IBM has initiated strategic partnerships with 22 states and school districts, which are utilizing IBM technology and technical assistance to eliminate key barriers to school reform and

improve student performance. Mr. Gerstner is a member of the Board of Overseers of the Annenberg Institute for School Reform at Brown University.

He has received numerous awards for his work in education, among them the Cleveland E. Dodge Medal for Distinguished Service to Education - Teachers College, Columbia University, and the Distinguished Service to Science and Education award from the American Museum of Natural History.

Predecessor Companies

Q1. **When did IBM begin**? I've heard various dates, such as 1911, 1914, 1924 — so what is the official date?

A1. Interestingly, a case can be made for any of the five following dates on which to base IBM's anniversary:

September 30, 1889 — The incorporation of Bundy Manufacturing Co. (time recording equipment), the first of many components that eventually became the Computing-Tabulating-Recording Company, Inc. (C-T-R), and later IBM.

December 3, 1896 — Incorporation by Herman Hollerith of The Tabulating Machine Co. (punched card tabulating equipment), the part of C-T-R that eventually became IBM's principal line of business.

June 16, 1911 — Incorporation of C-T-R, which had acquired Computing Scale Company of America, The Tabulating Machine Company, International Time Recording Company of New York, and the Bundy Manufacturing Company. Only the first three businesses were represented in the C-T-R name. There were also a number of other companies formed after 1889 which had been acquired by the various C-T-R units prior to 1911.

May 4, 1914 — Thomas J. Watson, Sr., was hired as C-T-R's general manager. IBM has traditionally recognized this date as its anniversary.

February 14, 1924 — The name of C-T-R was changed to International Business Machines Corporation, a name which actually had been registered in New York since 1918. The name was first used in 1917 when International Business Machines Company, Ltd., was established in Canada.

Q2. What were the **origins of IBM**?

A2. The earliest roots of IBM can be traced back to a set of events that took place in the 1880-1890 period.

First, in 1885, Julius E. Pitrat of Gallipolis, Ohio, secured a patent on an entirely new device which he called a computing scale. That invention became the earliest component of what later became the International Business Machines Corporation. From it, in great part, grew the entire business of what for many years was known as the Dayton Scale Division of IBM.

While Pitrat was at work on his scale, Dr. Herman Hollerith, a distinguished statistician who had been employed by the U.S. government in the compilation of the 10th Census, was wrestling in Washington, D.C., with the problem of reducing the mountain of facts gathered by census-takers into usable form. He set out to find a way by which all the recording, tabulating and analyzing of a body of fact could be done by machinery. The system he devised was fundamentally simple. It

consisted essentially of a method of recording the facts of any given situation — for example, the description of one person — by punching a definite pattern of holes in a piece of paper. While Hollerith's original plan used strips of paper, he soon found it was better to use a separate card of standard size and shape for each "unit situation." A prearranged code assigned a definite meaning to each separate position on the card. A hole punched in that position would then actuate electrically-operated mechanisms which dealt with the particular data represented by that position. Hollerith's first customer was the City of Baltimore. Other early users of Hollerith's machines were the Bureau of Vital Statistics in New Jersey and the Board of Health in New York City.

Thus, with Pitrat in Ohio and Hollerith in Washington, two building blocks of the future IBM were put in place. Meanwhile, work was going forward that would result in the third major element in IBM's early 20th century business — the accurate and efficient recording of time.

In 1888, William L. Bundy, a jeweler in Auburn, N.Y., devised a mechanism by which workers were given individual keys to insert in a time-recorder as a means for logging arrivals and departures at work. That same year, Dr. Alexander Dey patented a time recorder that avoided the use of separate keys by allowing workers to swing a pointer on his machine — the Dey Time Recorder — to their own employee number, push the punch in the corresponding hole, thereby causing the time record to be printed opposite the employee number on a prepared sheet inside the machine.

Then, beginning in 1889, those early innovations and the following developments led to commercial organizations which later evolved into IBM:

Bundy Manufacturing Company. Incorporated in 1889 by Harlow E. Bundy, Willard Bundy, George E. Green and A. Ward Ford as the first time-recorder company in the world.

Computing Scale Company. Incorporated by Orange O. Ozias and Edward Canby, in Dayton, Ohio, in 1891, after acquiring the Pitrat patents and beginning to manufacture the world's first computing scales in 1889. In 1893, Samuel M. Hastings and Walter K. Mills were appointed general sales agents for the company in four Midwestern states, an appointment that led to a national sales organization.

Tabulating Machine Company. Incorporated by Hollerith in 1896.

Dey Patents Company. Incorporated at Syracuse, N.Y., in 1893. (The name was soon changed to Dey Time Register Company.)

Willard and Frick Manufacturing Company. Daniel M. Cooper patented the world's first card time-recorder in 1894. He and J.L. Willard and F.A. Frick formed a company to market Cooper's invention under the trade name "Rochester."

Stimson Computing Scale Company. Organized in Detroit in 1896 and later included in the mergers and consolidations out of which IBM was formed.

Moneyweight Scale Company. Organized in 1899 and also later included in the mergers and consolidations leading to the eventual formation of IBM.

International Time Recording Company. Organized in 1900 by George W. Fairchild to take over the properties of the Bundy Manufacturing Company and its newly acquired subsidiary, the Standard Time Stamp Company, and the Willard and Frick Manufacturing Company. In 1906, having outgrown Bundy's Binghamton, N.Y., plant, the company began work on a new factory building in Endicott, N.Y., and all operations were transferred to the new plant in August 1907. Also in 1907, International Time Recording Company purchased the Dey Time Register Company, and transferred the manufacture of dial recorders to Endicott.

Computing-Tabulating-Recording Company. The continued progress of the Computing Scale Company of America, the International Time Recording Company and the Tabulating Machine Company attracted the attention of Charles R. Flint, a businessman and financier. He became convinced that a merger of the three companies would result in a formidable business institution. Around 1910, he approached the three companies with merger proposals, and on June 16, 1911, C-T-R was incorporated as a holding company to assume ownership of the three parent concerns. C-T-R's board then sought an executive not previously identified with any of the component companies to weld them impartially into a single harmonious unit. Thus, in 1914, Thomas J. Watson, Sr., was hired as C-T-R's general manager, an event that led to the creation of IBM.

Products & Services

Q1. What was the Type **1**?

A1. Introduced in 1921, the IBM 1 Printing Tabulator was an important milestone in IBM's history because it was the first fully automatic card controlled machine. Its features included item listing from each card, total printing, adding only at higher speed, automatic group control (which eliminated the use of stop cards), automatic counter reset and a restarting device for the card feed. The Type 1 operated at between 75 and 150 cards a minute.

Q2. What is the **016**?

A2. The development of automatic feeding and ejecting mechanisms for keypunches and duplicators helped to increase the speed of key punching and reduce operator fatigue. The IBM Type 016 Electrical Duplicating Keypunch, introduced in 1929, fed cards into the punching unit and automatically removed or ejected the cards after punching. It was withdrawn from marketing in 1960.

Q3. What was the IBM Type **31**?

A3. Alphabetical duplicating key punches recorded alphabetic information in tabulating cards so that complete words and names, together with numerical data, could be later printed by an alphabetical accounting machine. The Type 31 Alphabetical Duplicating Punch was introduced by IBM in 1933, and it automatically ejected one card and fed another in 0.65 second. These machines were equipped with separate alphabetical and numerical keyboards. The alphabetical keyboard was similar to a conventional manual typewriter except that the shift, tab, backspace and character keys were eliminated, and a skip, release, stacker and "1" key were provided.

Q4. What was the IBM **63**?

A4. Announced in August 1948, the Type 63 Card Controlled Tape Punch was able to read alphabetical and numerical information in IBM punched cards and perforate five-channel telegraphic tape with that data. (One roll of punched tape was the equivalent of approximately 1,500 cards.) The machine consisted of a card reading unit and a tape punching unit. The Type 63 was withdrawn from marketing in January 1972 — after nearly a quarter-century in the IBM product lineup.

Q5. What was the Hollerith **070** Sorter?

A5. The original Hollerith electric tabulating system did not have an adequate method for sorting cards. This became a problem in the 1900 agricultural census, so Herman Hollerith (1860-1929) developed an automatic sorter. The first one was a tabletop model with the bins arranged horizontally. Later, when his system was gaining favor commercially, Hollerith redesigned the sorter into a sturdier, vertical machine that would not take up too much space in

small railroad offices. The 070 Vertical Sorting Machine of 1908 could operate at a rate of 250-270 cards a minute.

Q6. What was the Type **71**?

A6. Introduced in 1928, the IBM Type 71 Vertical Sorter automatically grouped cards of similar classification and at the same time arranged such classifications in a numerical sequence. It was equipped with 12 pockets, corresponding to the 12 punching positions on a card, with a capacity of 80 cards each at a speed of 150 cards a minute.

Q7. What was the Type **077**?

A7. Introduced in 1937, the Type 077 collator fed and compared two sets of punched cards simultaneously to match or merge them. While doing so, the collator could separate the cards which matched from those that did not, making it possible to pull or file the cards automatically. The Type 077 was withdrawn from marketing in November 1957.

Q8. What was the IBM Type **80**?

A8. The Type 80 Electric Punched Card Sorting Machine was the first horizontal card sorter, introduced by IBM in 1925 to operate at almost twice the speeds of the older Type 70 vertical sorter. It could process up to 450 cards a minute. This machine used a direct magnetically operated control for the chute blades which replaced a much more complex mechanical device in the older machine. The Type 80 grouped all cards of similar classification (such as "sales by products") and at the same time arranged such classifications in numerical sequence. With 10,200 units on rental at the close of 1943, the Type 80 had the largest inventory for any machine at that time. It was withdrawn from marketing in 1956.

Q9. What was the **090**?

A9. The Type 090 Non-Printing Tabulator was one of the most successful tabulators of the early 1900s. It was the first machine to read punched-card data automatically and to simultaneously accumulate totals of multiple-integer numbers. A plug board permitted the operator to change the program of electrical circuits. The Type 090 remained in the product line until 1948.

Q10. What was the **095**?

A10. The IBM 095 Punched Card Counter was introduced in 1920 to record and calculate transactions and data. Equipped with 14 counters, the 095's flexibility made it especially adaptable for compiling statistics by large businesses and organizations.

Q11. What was the IBM **301** (Type IV)?

A11. The 301 (better known as the Type IV) Accounting Machine was the first card-controlled machine to incorporate class selection, automatic subtraction and printing of a net positive or negative balance. Dating to 1928, this machine exemplifies the transition from tabulating to accounting machines. The Type IV could list 100 cards per minute.

Q12. What was the IBM **305** RAMAC?

A12. IBM announced the 305 Random Access Memory Accounting Machine (RAMAC) on September 13, 1956, as a "revolutionary new product to accelerate the trend toward office and plant automation." It made "continuous accounting" or "in-line data processing" possible, whereby all affected records are adjusted immediately after a transaction occurs.

The 305 system was built around a magnetic disk memory unit with a storage capacity of five million digits. Information in the form of magnetic spots was stored on both sides of 50 metal disks, arranged in a vertical stack which rotated at 1,200 revolutions a minute. An access arm moved rapidly up and down, reaching between the spinning disks to retrieve the stored data. After processing, the information obtained was reproduced by the printer unit or punched into IBM cards. RAMAC could record or recall information from magnetic disks in milliseconds and in any sequence.

The monthly rental for a basic RAMAC was $3,200, of which $650 was for the disk storage unit, $1,625 for the processing unit and power supply, and $925 for the console, printer and card punch. More than a thousand of these vacuum tube-based computers were built before production ended in 1961.

Q13. What was the **401**?

A13. The 401, introduced in 1933, was an early entry in a long series of IBM alphabetic tabulators and accounting machines. It was developed by a team headed by J. R. Peirce and incorporated significant functions and features invented by A. W. Mills, F. J. Furman and E. J. Rabenda. The 401 added at a speed of 150 cards per minute and listed alphanumerical data at 80 cards per minute.

Q14. What was the IBM Type **405**?

A14. Introduced in 1934, the 405 Alphabetical Accounting Machine was the basic bookkeeping and accounting machine marketed by IBM for many years. Important features were expanded adding capacity, greater flexibility of counter grouping, direct printing of entire alphabet, direct subtraction and printing of either debit or credit balance from any counter. Commonly called the 405 "tabulator," this machine remained the flagship of IBM's product line until after World War II.

Q15. What is the **501**?

A15. Brought to market in 1926, the IBM Type 501 Automatic Numbering Gang Punch automatically recorded on a series of punched cards common fixed data from a master card. This punch operated at the rate of 125 cards per minute, and was withdrawn from marketing in April 1948.

Q16. What was the IBM **550**?

A16. Introduced in 1930, the IBM 550 Automatic Interpreter was the first commercial IBM machine capable of sensing numerical data punched in cards and printing such data across the top of each card. A plugboard enabled the printed information to be placed in any sequence. The machine automatically interpreted at the rate of 75 cards a minute or 4,500 cards an hour. The feeding hopper had a capacity of 800 cards, and the stacker in which the interpreted cards were deposited had a capacity of 1,000 cards. The 550 was used in checking, filing, selection and reference applications.

Q17. What was the Type **552**?

A17. The Type 552 Alphabetic Interpreter was announced in 1937. It translated the holes punched in IBM cards and printed the corresponding numerical and alphabetic data across the face of the card while processing 60 cards per minute. The Type 552 was withdrawn in December 1957.

Q18. What was the IBM **600**?

A18. The Type 600 Automatic Multiplying Punch was announced in 1931 as the first machine that could read numbers from a card, multiply the numbers together and punch the answer in the same card. Later, features were added that permitted cross-addition, group multiplying, subtraction and class selection of items to perform complex calculations.

Q19. What was the IBM **650**?

A19. Announced as the IBM 650 Magnetic Drum Calculator in July 1953, the 650 became the most popular computer of the 1950s. It was operated by coded instructions stored on a magnetic drum, and was used to solve commercial or technical problems.

The basic IBM 650 consisted of two units — IBM 650 Console Unit and IBM 655 Power Unit. Some of the 650's features as described in IBM publications of the time were:

- Magnetic Drum Memory — 20,000 digit (2,000 word) or 10,000 digit (1,000 word).
- Stores data and instructions governing proper operation for each step in a procedure.
- Automatic table look-up.
- Console permits visible inspection of any machine location and altering of instructions.
- Discrepancies automatically detected and indicated on a visible panel through programming.

The 650 was viewed as the foundation of a flexible and integrated “building block” data processing system. IBM machines could be added to the 650 to provide for punched card input-output, line printed output, magnetic tape input-output, high-speed magnetic core storage, indexing accumulators, and automatic floating-decimal arithmetic in various combinations.

By the time the last IBM 650 was manufactured in 1962, nearly 2,000 of the machines had been delivered to customers — the most of any electronic computer of that period.

Q20. What was the IBM **701**?

A20. The 701 Electronic Data Processing Machines System, introduced in 1952, was IBM’s first commercially available scientific computer and the first IBM machine in which programs were stored in an internal, addressable electronic memory. Using cathode ray tube (Williams tube) memory for speed and flexibility, the 701 could process more than 2,000 multiplications and divisions a second. From the 701 technology came not only the 702, 704, 705 and 709 computers but also a new orientation to the electronic stored-program computer.

Q21. What was the IBM **704**?

A21. The IBM 704 Electronic Data Processing Machine, introduced in 1954, was the first large-scale commercially available computer to employ fully automatic floating point arithmetic commands. It was a large-scale, electronic digital computer used for solving complex scientific, engineering and business problems. Input and output could be binary, decimal, alphabetic or special character code, such as binary coded decimal which includes decimal, alphabetic and special characters. A key feature of the 704 was FORTRAN (Automatic Formula Translation), which was an advanced program for automatically translating mathematical notation to optimum machine programs.

A contemporary IBM publication listed the following features for the 704:

- 32,768, 8,192 or 4,096 words of high-speed magnetic core storage. (A word consists of 36 binary digits — slightly larger than a 10 decimal digit number).
- Any word is individually addressable.
- Any word in magnetic core storage can be located and transferred in 12 millionths of a second.
- Single address type stored program controls all operations.
- Internal number system is binary.
- Executes most instructions at a rate of 40,000 per second.
- Built-in instructions provide maximum flexibility with minimum programming.
- A parallel machine, it operates on a full word simultaneously.
- Magnetic tape input-output units permit masses of data to enter and leave the internal memory of the machine at high speed.
- Auxiliary tape-to-card, card-to-tape, and tape-to-printer operations can be performed with additional IBM equipment.

Q22. What was the IBM **705**?

A22. When the IBM 705 Electronic Data Processing Machine was launched in 1954, it was one of the most powerful data processing systems then available, and with the IBM 704, the first commercial machines with core memories. Developed primarily to handle business data, it could multiply numbers as large as one billion at a rate of over 400 per second.

The 705 was made up of a Central Processing Unit and various types and combinations of input and output units.

The computer's memory consisted of tiny ferrite cores strung on frameworks of wire. Some 20,000 or 40,000 alphabetic and numerical characters were stored on magnetized cores. Words, numbers or instructions were represented by the magnetic or neutral state of groups of cores, and were available for calculation in millionths of a second — the fastest electronic storage of the time. Problems which had previously required weeks or months to solve could be handled by the 705 in a matter of minutes.

In a 1954 IBM publication, the 705 was credited with the following features:

- Forty thousand or twenty thousand characters of high-speed magnetic core storage.
- Any one of the characters in magnetic core storage can be located or transferred in 17 millionths of a second.
- Any one of these characters is individually addressable.
- Magnetic tape input-output units permit masses of data to enter and leave the internal memory of the machine at high speed.
- A simultaneous read and write feature permits recording of tape during the same cycle that reading takes place.
- The flexibility of the system allows any reasonable number of input or output devices.
- Stored instructions can be modified at will.
- Automatic checking devices keep the operations under constant electronic scrutiny for accuracy.

Q23. What was the IBM **709**?

A23. The IBM 709 Data Processing System was introduced in January 1957, and was the first equipment of its capacity to work with equal facility on both commercial and scientific or engineering problems. Like the 704 and 705, the 709 also featured rapid access, high capacity magnetic core "memory." Another aid to the 709's high-powered operation was a new data synchronizer unit which permitted the system to read, write, and calculate simultaneously.

The 709 used instructions unlike any of those found in contemporary stored program computers. Developed to provide greater programming flexibility, they included conversion instructions which permitted the machine to rapidly perform calculations on data prepared in number systems other than the 709's basic system of binary arithmetic. That meant that all problem data could be kept in whatever form was most economical and desirable for the work at hand, rather than in a number system compatible to the computer.

Arithmetical operations were performed by the IBM 709 at "amazingly high speeds," according to the 1957 IBM announcement press release. The release also reported that:

> The new system can handle up to 42,000 additions or substractions a second; multiplications or divisions are performed at speeds of up to 5,000 a second. An important contributing factor to this extraordinary calculating speed is the 709's rapid access, high capacity core storage or "memory." Up to 32,768 "words" of problem or instruction data can be held in core storage, a "word" being equal to a ten decimal digit number. This means that the equivalent of over 327,000 decimal digits can be stored in the 709's magnetic core storage. Any "word" in core storage can be located and made ready for use in only 12 millionths of a second. The magnetic core storage unit's tremendous capacity fulfills the need for completely internal high-speed handling of voluminous problem data, reference tables, and lengthy programs.

The IBM 709 was withdrawn from marketing in April 1960.

Q24. What was the IBM **726**?

A24. The 726 Magnetic Tape Recorder, introduced in 1952 as IBM's first magnetic tape unit, could store 100 characters of information on one inch of tape and it could read and write information at the rate of 75 inches a second.

Q25. What was the IBM **729** II?

A25. Brought to market in September 1958, the 729 II Magnetic Tape Unit combined compact storage facilities and high-speed input/output operations for the IBM 1410 Data Processing System. Up to 20 tape units could be attached to the 1410. The 729 II had a read-write speed of 15,000 or 41,667 characters per second, a recording density of 200 or 556 characters to the inch, and a high-speed rewind capability of 1.2 minutes per 2,400 foot reel. When recorded information was no longer needed, the tape could be used to record and store new data; the write operation automatically erased old information. The 729 II was withdrawn from marketing in December 1971.

Q26. What was the IBM **1013**?

A26. Announced in October 1961, the 1013 Card Transmission Terminal transmitted data from punched cards at speeds up to 300 characters per second (cps) and punched received data into cards at a rate of 160 cps. When transmitting, data in the punched cards was photosensed and entered into buffer storage. Once there and under the control of the 1013's stored program, data could be added, deleted or sequentially stored for transmission. In addition, the 1013 automatically detected errors and retransmitted corrected data. It was withdrawn from marketing in January 1977.

Q27. What was the IBM **1050**?

A27. The 1050 Data Communications System was a multipurpose, station or office-oriented data communication terminal system that was announced in March 1963 specifically for important data record keeping and transmission functions. It operated over established communication lines to provide rapid, dependable communications between remote locations

and a central data processing site. The 1050 system consisted of the 1051 control unit, 1052 printer-keyboard, 1053 printer, 1054 paper tape reader, 1055 paper tape punch and 1056 card reader. These various components were withdrawn from marketing between February 1974 and June 1978.

Q28. What was the IBM **1130**?

A28. The IBM 1130 Computing System was announced in February 1965 as the "lowest-priced stored program computer ever marketed by IBM." Capable of performing 120,000 additions a second, the system was offered for lease for as little as $695 a month and for sale at $32,280. The 1130 used microelectronic circuits employing IBM's Solid Logic Technology similar to those used by the IBM System/360. It was manufactured in San Jose, Calif., and Greenock, Scotland.

Q29. What was the IBM **1301**?

A29. The 1301 Disk Storage Unit was announced in June 1961 with an ability to monitor as many as 280 million characters of information in a single system by making use of comb-like arms flying on layers of air. Compared with the innovative IBM RAMAC, the 1301 provided a thirteen fold increase in storage density and three times faster average access to information. The 1301 could be linked to any of five intermediate-to-large solid-state IBM computers (1410, 7070, 7074, 7080 and 7090) or shared by any two of them. One unit could store between 50 million and 56 million characters of information, depending on the computer to which it was connected. Up to five 1301s could be used in a single system. The 1301 was withdrawn from marketing in October 1970.

Q30. What was the IBM **1401**?

A30. The all-transistorized 1401 Data Processing System placed such features as high-speed card punching and reading, magnetic tape input and output, high-speed printing, stored program and arithmetic and logical ability in the hands of smaller businesses that had previously been limited to using conventional punched card equipment.

Announced in October 1959, the 1401 was equipped with ferrite-core memories having capacities of 1,400, 2,000 or 4,000 characters. The system could be configured to use punched-cards and magnetic tape, and could be used either as a stand-alone computer or as a peripheral system for larger computers. The 1401 processing unit could perform 193,300 additions of eight-digit numbers in one minute.

The monthly rental for a 1401 was $2,500 and up, depending on the configuration. By the end of 1961, the number of 1401s installed in the United States alone had reached 2,000 — representing about one out every four electronic stored-program computers installed by all manufacturers at that time. The number of installed 1401s peaked at more than 10,000 in the mid-1960s, and the system was withdrawn from marketing in February 1971.

Q31. What was the IBM **1402**?

A31. The 1402 Card Read-Punch could read card information into the IBM 1401 processing unit punch cards and separate them into radial stackers. The cards could be easily removed while the machine was running. Maximum speeds for the 1402 were 250 cards per minute for punching and 800 cards per minute for reading. Announced in October 1959, the 1402 was withdrawn from marketing in February 1971.

Q32. What was the IBM **1403**?

A32. When introduced in October 1959, the 1403 Printer was a completely new development providing maximum throughput of forms and documents in printing data from punched cards and magnetic tape. The printer incorporated a swiftly moving horizontal chain (similar in appearance to a bicycle chain) of engraved type faces, operated by 132 electronically-timed hammers spaced along the printing line. The impact of a hammer pressed the paper and ink ribbon against a type character, causing it to print. The chain principle achieved perfect alignment of the printed line and greatly reduced the number of sets of type characters needed. The 1403 printer could produce over 230 two-line documents, such as checks, per minute or the equivalent of a printing speed of 4,800 lines per minute. The 1403 was withdrawn from marketing in February 1971.

Q33. What was the IBM **1405**?

A33. The 1405 Disk Storage Unit was introduced in October 1960. To improve on IBM's RAMAC technology, the 1405 engineers doubled two parameters — tracks per inch and bits per inch of track — to deliver a fourfold increase in capacity. The 1405 storage units were available in 25 and 50 disk models, with 10 million and 20 million characters each, respectively.

The 1405 was used in Walnut, an information retrieval system that was developed for the U.S. Central Intelligence Agency and delivered in late 1962. Walnut was the first mechanized system that could feasibly store and search millions of pages of documents. The 1405 withdrawn from marketing in June 1970.

Q34. What was the IBM **1440**?

A34. Introduced by IBM in October 1962 as "one of the most important new products we have ever developed," the 1440 Data Processing System was a low-cost compact electronic computer designed specifically for small and medium-size business firms. It incorporated a major achievement in the data storage technology of the time — disk storage devices designed with interchangeable packs, each containing six magnetic memory disks for a combined storage capacity of nearly three million characters of information.

Besides the data packs, the 1440 contained the following other technological improvements: a card read-punch that used the solar cell principle to read information from punched cards directly into the central processing unit with increased accuracy and reliability; a printer equipped with five interchangeable type bars for greater versatility; a console that contained the operating keys,

dials and switches that permitted operator control over the system; and a central processing unit that had a core storage cycle of 11.1 millionths of a second.

The basic system, using the interchangeable disk packs, rented for about $2,600 monthly. The 1440 was withdrawn from marketing in February 1971.

Q35. What was the IBM **2361**?

A35. The IBM 2361 Core Storage Unit was introduced in April 1964 and built by IBM's Poughkeepsie, N.Y., manufacturing facilities with 16 times the capacity of any previous IBM memory. In each 2361, almost 20 million ferrite cores — tiny doughnut-shaped objects, each about the size of a pinhead — were strung in two-wire networks and packaged, with associated circuitry, into a cabinet only five by 2 ½ feet and less than six feet tall. The 2361's design provided for storage of 524,000 36-bit words and a total cycle time of eight microseconds in each memory. The 2361 was the first IBM memory to use two-wire core storage to increase storage capacity, improve performance and reduce unit size.

Cores were woven into each juncture of a screen-like mesh of wire to form a plane resembling a small window screen. Memory circuits were associated with core planes in the 2361 and included some 3,500 Solid Logic Technology modules and 35,000 high-current silicon diodes. Major feats in fabricating the 2361 included soldering and testing 180,000 connections, and welding and testing another 180,000 connections.

The 2361 was withdrawn from marketing in April 1965.

Q36. What was the IBM **3033**?

A36. Designed as a successor to the System/370 Model 168, the 3033 Processor was announced in May 1977. It was half the size, consumed half the power, required half the cooling and was nearly twice as fast as the 168. IBM manufactured the 3033 in Poughkeepsie and Kingston, N.Y.; Montpellier, France; and Yasu, Japan. The 3033 was withdrawn in February 1985.

Q37. What was the IBM **3081**?

A37. The IBM 3081 Processor Complex joined the IBM product line in November 1980. It offered 16, 24 or 32 million characters of main storage and had 16 or 24 integrated channels. The 3081 used a new "dyadic" design in which two processors, each with its own assigned set of channels, shared main processor storage and operated under a single control program. It had a maximum aggregate data transfer rate of 72 million characters per second and could attach to most direct access storage devices used with other large IBM processors. An IBM 3081 Processor Complex, which included a processor, processor controller, power unit, coolant distribution unit, systems and operator's consoles, with 16 channels and 16 million characters of main storage, could be purchased at time of announcement for $4,046,240, while a 24 channel, 32 million character IBM 3081 Processor Complex could be purchased for $4.6 million. Other models of the

3081 were introduced in October 1981, September 1982, March 1983 and February 1984. All models were withdrawn from marketing in August 1987.

Q38. What was the IBM **3090**?

A38. The most powerful IBM computer of its time, the 3090 high-end processor of the IBM 308X computer series incorporated one-million-bit memory chips, Thermal Conduction Modules to provide the shortest average chip-to-chip communication time of any large general purpose computer, and the industry's most advanced operating systems. Announced in February 1985, the Model 200 (entry-level with two central processors) and Model 400 (with four central processors) IBM 3090 had 64 and 128 megabytes of central storage, respectively. At the time of announcement, the purchase price of a Model 200 was $5 million, and the machine was available in November 1985. The Model 400 was available only as a field upgrade from the Model 200 at a cost of $4.3 million beginning in the second quarter of 1987. A later six-processor IBM 3090 Model 600E, using vector processors, could perform computations up to 14 times faster than the earlier four-processor IBM 3084.

Q39. What was the IBM **3270**?

A39. The 3270 Information Display System was announced by IBM in May 1971. Developed at IBM's facility in Kingston, N.Y., the 3270 system brought new simplicity to the gathering and communication of information. It could be attached to a System/370 or System/360 Model 25 or larger. The 3270 system was withdrawn from marketing in October 1977.

Q40. What was the IBM **3284**?

A40. Introduced in May 1971, the 3284 Hard Copy Printer was a cost-reduced printer that used the no-work wire matrix print head. A sprocket feed similar to that of a typewriter was used for paper feed along with a solenoid/ratchet mechanism. The 3284 ran at 40 characters per second. It was withdrawn from marketing in August 1982.

Q41. What was the IBM **3380**?

A41. Originally announced in June 1980, the IBM 3380 Direct Access Storage was available in six models. Each unit could store up to 2.52 billion bytes and had an average seek time of 16 milliseconds and a data transfer rate of 3.0 megabytes per second. The 3380 used advanced film head technology, higher density and new controller logic to achieve greater reliability and improved environmental characteristics (less floor space, electrical power and heat dissipation than any previous IBM disk storage product on an equal capacity basis). Some models of the 3380 were withdrawn in October 1981 and May 1986, and newer models were announced in September 1987.

Q42. What was the IBM **3705**?

A42. To reduce the load placed on host computers by network communications, IBM announced the 3705 Communications Controller in March 1972. It could coordinate transmission between a computer and remote terminals on up to 352 telephone lines — twice the capacity of any previous IBM control unit. Equipped with its own small processor and memory capacity of up to 240K, it could be programmed to emulate prior transmission control devices and to perform many of the line management and data conversion tasks formerly handled by System/360 host computers. It operated with all models of the System/370, and almost all the terminal devices offered by IBM could be linked to the 3705. The 3705 was withdrawn from marketing in December 1985.

Q43. What was the IBM **3850**?

A43. The "honeycomb" cell structure of the IBM 3850 Mass Storage System, introduced in 1974, stored small cartridges containing spools of magnetic tape. Each spool could store 50 million characters of information, and up to 472 billion characters could be economically filed in one 3850 system for online computer use.

Q44. What was the IBM **3890**?

A44. Announced in 1973, the 3890 Document Processor was designed to help banks to process and distribute more checks faster and with fewer errors. It could read and sort a minimum of 2,400 six-inch documents per minute, and could print a batch and identification number on each document to improve item control. Equipped with its own control and program storage, the 3890 could be linked directly to virtual storage models of IBM System/370 or used independently for fine sorting operations.

Q45. What was the IBM **4341**?

A45. Introduced in January 1979, the 4341 Processor provided high system performance for commercial, engineering, scientific and academic users of intermediate size System/370s and large System/360s. It was available in two model groups. Model Group 1 had an internal performance rate up to 3.2 times faster than the System/370 Model 138 and up to four times the processor storage capacity of the 138. Model Group 2 had an internal performance rate up to 1.8 times that of Model Group 1 and a processor storage capacity up to two times that of Model Group 1. The 4341 was withdrawn from marketing in February 1986.

Q46. What was the IBM **4381**?

A46. Boasting of state-of-the-art technology, IBM launched the 4381 processor in September 1983 to reenforce the company's commitment to professional, engineering and scientific users. Available in Model Groups 1 and 2, the 4381 was developed in IBM's Endicott, N.Y., facility and manufactured in Endicott; Vallencia, Spain and Sumare, Brazil. The 4381 bridged the gap in the 1980s between IBM's intermediate 4300 processors and the larger 308X processors. Among its technology advances were high-density, 64-millimeter-square modules that contained a maximum of 36 Large Scale Integration chips each, achieving up to 25,000 circuits per module.

Users could obtain up to 16 megabytes of memory with the 4381, and up to 12 input/output channels. The 4381 was withdrawn from marketing in February 1986.

Q47. What was the Style **5011**?

A47. The Style 5011 was a ¼ horsepower electric coffee mill manufactured in the 1920s and early 1930s IBM's Dayton Scale Company — formerly, the Computing Scale Company of America and later, an IBM division — and was priced at about $135.

Q48. What was the IBM **5100**?

A48. Weighing approximately 50 pounds, the 5100 Portable Computer was announced in September 1975 to put computer capabilities at the fingertips of engineers, analysts, statisticians, and other problem-solvers. Available in 12 models providing 16K, 32K, 48K or 64K positions of main storage, the 5100 sold for between $8,975 and $19,975. A late-1960's computer with the equivalent capacity and performance of the 5100, would have been nearly as large as two desks and would have weighed about half a ton. The 5100 was withdrawn in March 1982.

Q49. What was the Style **5117**?

A49. The Style 5117 was a ½ horsepower meat chopper offered by IBM's Dayton Scale Division in the late-1920s.

Q50. What was the IBM **6670**?

A50. IBM's Office Products Division introduced the 6670 Information Distributor in February 1979 as a versatile office information distributor that printed with a laser and received and transmitted documents electronically over ordinary telephone lines. The 6670 also linked word processing and data processing, printing computer-based information in typewriter-like quality originals using customized formats. It could print multiple sets of documents at speeds of up to 1,800 characters per second and could also function as a high-quality copier. The 6670 was withdrawn from marketing in August 1986.

Q51. What was the IBM **7030**?

A51. The IBM 7030 Data Processing System — or "Stretch" computer — was delivered in April 1961, offering a performance that was 200 times faster than the IBM 701, 40 times faster than the IBM 709 and seven times faster than the IBM 7090. Although the 7030 was the industry's fastest computer in 1961, its performance was far less than originally predicted. IBM cut its price from $13.5 million to $7.8 million and offered the 7030 to only eight customers.

Q52. What was the IBM **7090**?

A52. The fully transistorized IBM 7090 Data Processing System, announced in January 1959, was at the time of its introduction the most powerful data processing system to be marketed

commercially by IBM. The system had computing speeds up to five times faster than those of its predecessor, the IBM 709. That increase in performance was made possible by the use of thousands of ultra-fast transistors within the central processing unit of the computer.
Among the scientific applications for which the 7090 was suited were the design of missiles, rockets, jet engines, supersonic aircraft and nuclear reactors. In addition, the system was able to handle such commercial applications as inventory control, production control, payrolls and general accounting.

Capabilities of the 7090 computer system included performing 210,000 additions or subtractions a second. More than 32,000 10-digit numbers could be stored in its magnetic core storage. Any of these problem or instruction numbers could be located and made ready for use in 2.4 millionths of a second.

The 7090 could simultaneously read and write at the rate of 3 million units of information a second. The ability to read, write and compute at the same time was provided by the system's new Data Multiplexor. Each channel could have a total of ten magnetic tape units, a card reader, a card punch and a printer. A maximum 7090 system could include 80 magnetic tape units, eight card readers, eight printers and eight card punches.

General purpose programs (sets of instructions) developed for the IBM 709 could be used on the 7090, as were hundreds of programs developed for the IBM 704 computer. The means of input and output (entering problems and receiving solutions) was compatible with all contemporary IBM systems, *i.e.*, people familiar with the 709 would require a minimum of retraining to gain a technical knowledge of the 7090.

The use of long-life transistors provided increased reliability, decreased maintenance and a greatly stepped up operating speed of logical circuitry. Other advantages included compactness and a substantial reduction in power consumption and installation costs.

The IBM 7090 was withdrawn from marketing in July 1969.

Q53. What was the IBM **7094**?

A53. Announced in January 1962, the IBM 7094 Data Processing System was built at the company's Poughkeepsie, N.Y., plant. The system was designed for large-scale computing and to process complex scientific information at ultrahigh speed.

With a memory reference speed of two microseconds (millionth of a second), the 7094 could in one second perform 500,000 logical decisions, 250,000 additions or subtractions, 100,000 multiplications or 62,500 divisions. The 7094 internally performed mathematical computations 1.4 to 2.4 times faster than the IBM 7090, depending on the technique used to solve problems. High-speed data tapes enabled the 7094 to accept and record data at speeds of up to 170,000 characters a second.

A typical 7094 sold for $3,134,500. IBM provided customers with a complete package of 7090/7094 programs, including FORTRAN, COBOL, input-output control system and sorting, without charge.

The 7094 was withdrawn from marketing in 1969.

Q54. What is the IBM **AS/400**?

A54. When the Application System/400 (AS/400) was introduced in June 1988, it was the largest worldwide product announcement in IBM history. More than 100,000 customers, IBM business partners, consultants, analysts, vendors, reporters and IBM branch people in more than 140 locations were linked to the main product unveiling in New York City. Rolled out that day were six AS/400 models and more than 1,000 software packages. The AS/400 family at announcement offered a 10-fold performance range from the smallest to the largest model in the number of commercial transactions it could process per hour — up to 45,000 in IBM benchmark tests.

Among the product's attributes cited by IBM at the time of its introduction were the AS/400's integrated, state-of-the-art system; reliability; largest application library of any multi-user system in the industry; most productive system for developing applications in the industry; improved ease of use for both new and experienced users; unsurpassed connectivity with IBM systems, such as the System/370, System/36 and System/38; extremely fast processing (twice that of the high-end System/38 and five times that of the high-end System/36); adherence to IBM's Systems Application Architecture; ability to provide a total office solution; electronic customer support and online education. The AS/400 today remains one of IBM's most popular products — with more than 650,000 systems shipped around the world.

Q55. What was the Automatic Sequence Controlled Calculator (**ASSC**)?

A55. The Automatic Sequence Controlled Calculator (Harvard Mark I) was the first operating machine that could execute long computations automatically. A project conceived by Harvard University's Dr. Howard Aiken, the Mark I was built by IBM engineers in Endicott, N.Y.

A steel frame 51 feet long and eight feet high held the calculator, which consisted of an interlocking panel of small gears, counters, switches and control circuits, all only a few inches in depth. The ASSC used 500 miles of wire with three million connections, 3,500 multipole relays with 35,000 contacts, 2,225 counters, 1,464 tenpole switches and tiers of 72 adding machines, each with 23 significant numbers. It was the industry's largest electromechanical calculator.

Q56. What was the **Card-Programmed Electronic Calculator**?

A56. The IBM Card-Programmed Electronic Calculator was announced in May 1949 as a versatile general purpose computer designed to perform any predetermined sequence of arithmetical operations coded on standard 80-column punched cards. It was also capable of

selecting and following one of several sequences of instructions as a result of operations already performed, and it could store instructions for self-programmed operation.

The Calculator consisted of a Type 605 Electronic Calculating Punch and a Type 412 or 418 Accounting Machine. A Type 941 Auxiliary Storage Unit was available as an optional feature.

All units comprising the Calculator were interconnected by flexible cables. If desired, the Type 412 or 418, with or without the Type 941, could be operated independently of the other machines. The Type 605 could be used as a Calculating Punch and the punch unit (Type 527) could be operated as an independent gang punch.

Customer deliveries of the CPC began in late 1949, at which time more than 20 had been ordered by government agencies and laboratories and aircraft manufacturers. Nearly 700 CPC systems were delivered during the first-half of the 1950s.

Q57. What was the International Daily **Dial** Attendance **Recorder**?

A57. Manufactured by IBM's International Time Recording Co. division in the 1930s, the daily attendance recorder came in three sizes — for 50, 100 and 150 employees — and with either a single or double drum. The double drum models had a capacity for two daily sheets which automatically positioned themselves for the current day's records. When one sheet was used, a new one moved into place and a new sheet could be substituted for the completed record at any time during the day. The single drum dial recorder required that the sheets be replaced after working time or before starting time in the morning.

Q58. What was the IBM **Displaywriter** System?

A58. The IBM Displaywriter System was introduced in June 1980 to help users produce high quality documents while keying text at a productive, rough draft speed. Operators could automatically indent text, justify right margins, center, underscore and perform block commands. Documents could be stored and recalled for later review or revision. The system could check the spelling of approximately 50,000 common words and up to 500 technical terms or industry-unique words. The basic IBM Displaywriter consisted of a display station, that included a keyboard, along with a printer and a single diskette unit with a capacity of approximately 284,000 characters of information. With the growing acceptance of the IBM Personal Computer and its follow-ons, all models of the Displaywriter were withdrawn from marketing in April 1986.

Q59. What was the IBM **Enterprise System/9000**?

A59. When the System/390 line was introduced in September 1990 as IBM's most comprehensive announcement of products, features and functions in more than a quarter century, it included the IBM Enterprise System/9000 family of 18 new processors. One measure of the announcement's breadth was that a total of 23 different IBM manufacturing and development sites around the world were involved in the roll-out. The new processor family provided

significant price-performance gains and flexible growth options spanning a 100-fold performance range increase from the smallest (model 120) to the most powerful (model 900 six-way multiprocessor). The ES/9000s exploited new technologies, such as high-speed fiber optic channels with IBM's new ESCON architecture, ultra-dense circuits and circuit packaging that provided higher performance, extended supercomputing capabilities and twice the processor memory previously available.

Basic purchase prices for the air-cooled processors of ES/9000 ranged from approximately $70,500 to $3.12 million. Basic purchase prices for the water-cooled models ranged from $2.45 million to $22.8 million.

Q60. What was the International Ornamental Floor ("**Grandfather**") Type Master **Clock**?

A60. A master clock was the controlling center of IBM's Self-Regulating Electric Time System, and it was the source of accurate time — up to within 10 seconds a month of correct time — for the various secondary time pieces, such as indicating clocks, attendance and job cost recorders, distributed throughout the system. The "Grandfather" style clocks, either No. 21 (spring-driven) or No. 31 (weight-driven), beat 60 times a minute, possessed self-winding movements and came finished in either red or brown mahogany. The clocks were marketed in the 1930s by the International Time Recording Company, an IBM division.

Q61. What was the **PC Convertible**?

A61. The IBM PC Convertible (IBM 5140) of 1986 featured the latest in surface mount technology, which permitted electronic components to be mounted onto circuit boards, allowing more components to be placed in a smaller area. Weighing less than 13 pounds, the 5140 combined full computing power with portability and compatibility with other IBM Personal Computers.

Q62. What was IBM's first **Personal Computer**?

A62. The IBM Personal Computer, developed at the Information Systems Division's Boca Raton, Fla., facility, was announced in August 1981 as the company's "smallest, lowest-priced computer system … designed for business, school and home." Selling for as little as $1,565, the PC used an Intel 4.77 megahertz processor and Microsoft's Disk Operating System. The machine offered memory capacities from 16K to 256K and either one or two diskette drives. An expanded system for business with color graphics, two diskette drives and a printer cost about $4,500. Many analysts have regarded the IBM PC as setting the industry standard for personal computers for both commercial and home users. The early models of the IBM PC were withdrawn from marketing in April 1982, and later models followed in December 1985.

Q63. What developments took place in the early years of IBM's **personal computer** business?

A63. Non-IBM personal computers were available as early as the mid-1970s, first as do-it-yourself kits and then as off-the-shelf products. They offered a few applications but none that justified widespread use.

Drawing on its pioneering SCAMP (Special Computer, APL Machine Portable) prototype of 1973, IBM's General Systems Division announced the IBM 5100 Portable Computer in September 1975. Weighing approximately 50 pounds, the 5100 desktop computer was comparable to the IBM 1130 in storage capacity and performance but almost as small and easy to use as an IBM Selectric Typewriter. It was followed by similar small computers such as the 5110 and 5120.

IBM's own Personal Computer (IBM 5150) was introduced in August 1981, only a year after IBM executives gave the go-ahead to Bill Lowe, the lab director in the company's Boca Raton, Fla., facilities. He set up a task force that developed the proposal for the first IBM PC. Early studies had concluded that there were not enough applications to justify acceptance on a broad basis and the task force was fighting the idea that things couldn't be done quickly in IBM. One analyst was quoted as saying that "IBM bringing out a personal computer would be like teaching an elephant to tap dance." During a meeting with top executives in New York, Lowe claimed his group could develop a small, new computer within a year. The response: "You're on. Come back in two weeks with a proposal."

Lowe picked a group of 12 strategists who worked around the clock to hammer out a plan for hardware, software, manufacturing setup and sales strategy. It was so well-conceived that the basic strategy remained unaltered throughout the product cycle.

Don Estridge, acting lab director at the time, volunteered to head the project. Joe Bauman, plant manager for the Boca Raton site, offered manufacturing help. Mel Hallerman, who was working on the IBM Series/1, stepped forward with his software knowledge and was brought in as chief programmer. And so it went. As word spread about what was going on, talent and expertise were drawn in.

Estridge decided early that to be successful and to meet deadlines, the group had to stick to the plan: to the use of tested vendor technology; a standardized, one-model product; open architecture; and the use of outside sales channels for quick consumer market saturation.

About a dozen people made up the first development team, recalls Dave Bradley, who wrote the interface code for the new product. "For a month, we met every morning to hash out what it was this machine had to do and then in the afternoons worked on the morning's decisions. We started to build a prototype to take — by the end of the year — to a then little-known company called Microsoft." The team beat that deadline. The engineers were virtually finished with the machine by April 1981, when the manufacturing team took over.

The manufacturing strategy was to simplify everything, devise a sound plan and not deviate. There was not time to develop and test all components. So they shopped for completely

functioning and pretested subassemblies, put them together and tested the final product. Zero defects was part of the plan.

On August 12, 1981, at a press conference in New York, Estridge announced the IBM Personal Computer with a price tag of $1,565. Two decades earlier, an IBM computer often cost as much as $9 million and required an air-conditioned quarter-acre of space and a staff of 60 people to keep it fully loaded with instructions. The new IBM PC could not only process information faster than those earlier machines but it could hook up to the home TV set, play games, process text and harbor more words than a fat cookbook.

The $1,565 price bought a system unit, a keyboard and a color/graphics capability. Options included a display, a printer, two diskette drives, extra memory, communications, game adapter and application packages — including one for text processing. The development team referred to their creation as a mini-compact, at a mini-price, with IBM engineering under the hood.

The **system unit** was powered by an Intel 8088 microprocessor operating at speeds measured in millionths of a second. It was the size of a portable typewriter and contained 40K of read-only memory and 16K of user memory, as well as a built-in speaker for generating music. Its five expansion slots could be used to connect such features as expanded memory, display and printing units and game "paddles." The unit also ran self-diagnostic checks.

Containing 83 keys, the **keyboard** was connected to the unit by a six-foot coiled cable, which meant users could rest it in their lap or on the desktop without moving the rest of the system. It also included such advanced functions for the times as a numeric keypad and 10 special keys that enabled users to write and edit text, figure accounts and store data.

Options included:

- A **printer** that could print in two directions at 80 characters per second in 12 different character styles, and also check itself for malfunctions and provide an out-of-paper signal.
- A **color/graphics monitor** with 16 foreground and background colors and 256 characters for text applications. Its graphics were in four colors.
- Multiple 32K and 64K **memory cards** that could be plugged into the option slots to increase memory to 256K.

The response to the announcement was overwhelming. One dealer had 22 customers come in and put down $1,000 deposits on the machines for which he could not promise a delivery date. By the end of 1982, qualified retail outfits were signing on to sell the new machine at the rate of one-a-day as sales actually hit a system-a-minute every business day. *Newsweek* magazine called it "IBM's roaring success," and the *New York Times* said, "The speed and extent to which IBM has been successful has surprised many people, including IBM itself."

As the popularity of the personal computer skyrocketed, a virtual cottage industry of software developers emerged to meet the demand for application solutions. Along with the demand for

software, the need to focus on complete customer solutions became apparent as the possibilities of desktop computing evolved.

To keep up with the personal computing market, IBM developed and introduced enhanced and faster models throughout the decade following the launch of the IBM Personal Computer. Here are some of those developments:

1981
In August: the IBM Personal Computer — a different type computer with a whole new image and ready to make computing a democratic process, along with DOS 1.0, a breakthrough in operating systems.

1982
In July-September: PC enhancements — main memory and diskette capacity is doubled; DOS 1.1 is shipped.

1983
In January: the IBM PC is announced worldwide.

In March: the Personal Computer XT — nine times the memory capacity and room to grow — is announced. DOS 2.0 is announced to support XT hard file and hierarchical directories.

In August: the Entry Systems Division (ESD) is formed to be responsible for worldwide development and product management, and U.S. manufacture of IBM's general purpose, low-cost personal-use computer systems. Philip D. Estridge named president of ESD.

In October: 3270 PC, PC/XT 370 — introduces a windowing technique to retrieve information from several sources and work with it.

In November: PCjr — the first IBM computer designed and priced specifically for the home, weighing in at less than nine pounds.

1984
In February: Portable Personal Computer — a 30-pounder that can travel where the work is — and DOS 2.1.

In July: PCjr enhancements — a new keyboard and expanded memory.

In August: Personal Computer AT — a new enormously powerful, multitask, multi-user computer — and DOS 3.0 to support the AT. Also, PC Network, which makes it possible for up to 1,000 PCs to be linked in a professionally-designed and installed broadband network. DOS 3.1 will support the PC Network.

1986
In January: IBM announces that the PC/XT will be built by the company in Guadalajara, Mexico.

In April: the PC Convertible — a small, powerful, easy-to-carry personal computer system. DOS 3.2 to support the convertible's 3.5-inch drive.

In September: Personal Computer XT Model 286, along with other enhancements.

1987

In April: the IBM Personal System/2 family of products. Includes: Model 30, in two desktop configurations using Intel's 8086 processor; Model 50, a desktop workstation; Model 60, with a floor-standing processor (both Models 50 and 60 use Intel's 80286 processor); and Model 80, a powerful floor-standing system in three configurations using Intel's 80386 processor. Micro Channel architecture is introduced in high-end models. And, to tap the greater power, two new strategic operating systems: DOS 3.3 and Operating System/2. OS/2 is the first offering of IBM Systems Application Architecture (SAA), a common framework for developing and using the same application programs on all IBM systems.

In August: PS/2 Model 25, an affordable model for business and education users.

In November: OS/2 Standard edition 1.0 and OS/2 Extended Edition 1.0.

1988

In January: Screen Reader is announced, the first release of the IBM Independence Series of products designed for computer users with special needs.

In June: PS/2 family expanded to include seven new desktop machines — the PS/2 Model 70; the PS/2 Model 50Z; and the PS/2 model 25 LS in various configurations.

Also in June: IBM announces that PS/2 manufacturing operations will move to Research Triangle Park, N.C. ESD Boca Raton laboratory becomes responsible for all U.S. hardware development for PS/2 products.

In July: a new, easier-to-use version of the Disk Operating System — DOS 4.0.

In September: the Model 30 286 — twice as fast and offering customers 25 times more memory capacity than the original Model 30.

In October: first shipment of Operating System/2 Standard Edition Version 1.1, which features an easy-to-use graphical interface called Presentation Manager.

In November: SpeechViewer, second product in the IBM Independence Series.

1989

In April: at COMDEX in Chicago, IBM demonstrates a PS/2 Model 70 A-21 using Intel's new i486 microprocessor.

In May: more PS/2 family members — the PS/2 Model 55 SX and the PS/2 Model P70 386. Both models support OS/2 and DOS Versions 3.3 and 4.0.

Also in May: new versions of OS/2 — OS/2 Standard Extended Editions Version 1.2 — which have significantly new functions, including many that reflect IBM's continued commitment to SAA.

In September: two new high-performance PS/2 Model 70s — the 386-A61 and the 386-061 and the PS/2 Model 30 286-E31, with a 30 MB fixed disk and using the Intel 80286 microprocessor.

In October: shipment of the 486/25 Power Platform — a full quarter ahead of schedule — making IBM the first company in the world to ship the industry's most powerful microcomputer processor.

In November: OS/2 LAN Server Version 1.2, which provides more capacity and function, increased file server performance and expanded communication support.

Also in November: PS/2 Wizard Adapter.

In December: Phone Communicator, a member of the Independence Series, for hearing- or speech-impaired users.

Also in December: PS/2 Model 70 486, the most powerful member of the PS/2 family.

1990
In March: several new models of the PS/2, busmaster adapters and peripherals. Includes: four new configurations of the PS/2 Model 80; two new configurations of the PS/2 Model 65 SX; the PS/2 Model 70 386-031; the PS/2 Micro Channel SCSI Adapter; the PS/2 Micro Channel SCSI Adapter with Cache; the PS/2 320 MB SCSI Fixed Disk Drive; the PS/2 60 MB or 120 MB SCSI Fixed Disk Drives and the PS/2 CD-ROM Drive.

In April: OS/2 Standard Edition 1.2 translated and made available worldwide.

In May: new, enhanced Model 25 286, available in two models, the 006 and 036.
In October: the first medialess PS/2, the Model 55 LS (LAN Station), ideally suited for use as a local area network workstation.

Also in October: two new PS/2 family members — the Model 95 XP 486 and the Model 90 XP 486 — unleash the power of the Intel i486 processor and feature a unique design that allows them to be upgraded for future technologies. Also announced: PS/2 Model 80-A16, -161, -081; PS/2 Model 65 SX-321; PS/2 486/33 Processor Complex Upgrade Option; PS/2 2.3 GB SCSI Tape Drive; PS/2 External Storage Enclosure for SCSI Devices; PS/2 XGA Display Adapter/A; PS/2 memory Module Kit; PS/2 256 KB Cache Option; PS/2 5.25-inch Slim High Diskette Drive. Also introduced: the OS/2 Standard Edition Version 1.3, a smaller, faster version of OS/2 and new releases of OS/2 Extended Edition and OS/2 LAN Server.

In November: PS/2 Model P75 486, extending the high function and performance of the Intel i486 microprocessor to portable systems, giving customers a high-end desktop computer to go.

In December: new in the Independence Series — THINKable — a multimedia software program for the PS/2 that can help therapists treat those suffering from injury or disability.

1991
In March: PS/2 L40 SX, a lightweight, durable battery-operated 386SX computer that gives customers desktop function anywhere it's needed.

In April: OS/2 2.0 — a 32-bit, advanced function operating system positioned as the platform of choice for the industry.

Also in April: the first computers with Intel's newest 486 SX microprocessors are shipped. PS/2 Model 90 XP 486 SX and Model 95 XP 486 SX offering advanced storage capabilities and enhanced graphics at an entry-level price.

In May: VoiceType, another edition to the Independence Series, makes operating a computer as easy as speaking.

In June: the midrange PS/2 product line is strengthened with announcement of Model 35 SX and LS, Model 40 SX and Model 57 SX. In addition, DOS 5.0, an improved entry-level operating system that requires less memory than earlier versions while delivering more features and functions, is introduced.

In June: PS/2 486/50 Processor Upgrade Option for Models 90 and 95 XP 486 systems — the industry's first use of the i486 50 MHz technology.

In just that initial ten-year period — the first decade following the launch of the IBM PC — IBM had steadily introduced personal computers that increased processing speed tenfold over the original PC, increased the instruction execution rate (MIPS) a hundred fold, grew system memory a thousand times (from 16KB to 16MB) and beefed up system storage by a factor of 10,000, from 160 KB to 1.6 GB. And that was just the beginning of many more achievements — such as the ThinkPad — yet to come

Q64. What is the IBM **Personal System/2**?

A64. Introduced in April 1987 by IBM's Entry Systems Division, the Personal System/2 family of PCs originally featured four systems — Models 30, 50, 60 and 80 — in a range of eight configurations providing customers with a variety of performance, memory and storage options. The Model 30 was an Intel 8-megahertz system, with either two 720K diskette drives or one 720K diskette drive and a 20-megabyte fixed disk drive. At the high end of the family, the Model 80 was a floor-standing machine running at 16 megahertz, containing one megabyte of memory and featuring a 44 megabyte fixed disk drive. A second 44 MB fixed disk drive could be added.

Prices ranged from $1,695 for the Model 30 with two diskette drives to $10,995 for the Model 80 with two fixed disk drives.

Q65. What is the background and history of the **punched** computer **cards** long associated with IBM?

A65. For many years, the punched card was so much an accepted part of business life that it had been taken for granted. But the ubiquitous punched card had quite an early history, going back nearly three centuries to when Basile Bouchon, an obscure French engineer, decided to improve the method of weaving. In 1725, Bouchon devised a means for controlling the action of weaving looms by using holes punched into a roll of paper. As needles were pressed against the coded paper, some came through the holes and others were held back. The loom's action as controlled by these selected needles formed the pattern of the fabric. Three years later, Bouchon and a master silk weaver, M. Falcon, substituted a series of rectangular perforated cards for the roll of perforated paper, becoming the first to use punched cards to store information and control a machine.

Their developments were the foundation for the growth and popularity of the punched card. Later, Joseph Marie Jacquard perfected the punched card loom. His idea was expanded by Charles Babbage, who was the first to think of using cards to control an "analytical engine." And finally it was Herman Hollerith, a statistician in the U.S. Census Department, who built on those earlier ideas and developed a punched card system for tabulating records, thereby becoming responsible for one of the most common methods of business communication in the 20th century.

The first application for Hollerith's punched card theory was in Baltimore where he persuaded authorities to let him tally the city's 1887 vital statistics. The first application on a large scale was in handling the population tabulations of the 1890 U.S. census. The 1890 cards were blank except for an identification number running down the right side. Hollerith divided the card into 240 separate positions or spots. Holes punched into these spots would indicate a person's age, education, income and so on. There was one card for each person counted. The early census card was six and 5/8 inches by three and ¼ inches in size and had 20 columns. Electromechanical sensing devices could automatically "read" where the holes were punched in each card and process the information. The 1890 census (of 63 million people) was tabulated in one-third the time it took for the 1880 count (of 50 million people), and $5 million in costs were saved.

Initial punched cards were usually a short card with 34 columns of information on a card with 45 columns, which was the same length and width as the "modern" data processing card. With the 1928 introduction of the 80-column card — each with 12 punching places and measuring seven and 3/8 inches by three and ¼ inches — storage capacity was nearly doubled.

One of the earliest commercial uses for these cards was in the compilation and analysis of freight statistics for a leading railroad. Later, the IBM card was modified to permit recording of data directly upon the card itself instead of punching a card from some other original document. After the U.S. Social Security Act was passed in the 1930s, millions of punched cards were processed in "the largest accounting operation of all time." By the 1970s, over one million cards were used

each minute of each work day. Some businesses used more than 70 million of the general purpose cards each year.

IBM card production was carried out at the company's plant in Endicott, N.Y. and plants devoted solely to the production of IBM cards were located in Washington, D.C.; San Jose, Calif.; and Greencastle, Ind. The cards were manufactured from specially prepared high-grade paper stock. Every care was taken to produce a paper strong in wearing quality and free from foreign particles which might act as conductors of electricity. Other tests included temperature and humidity control, tearing strength, folding endurance and porosity to ensure high printing quality of the paper. The card layout was designed by the IBM sales representative in cooperation with the customer.

Q66. What is the IBM RISC/6000 (or **RS/6000**)?

A66. The RISC System/6000 (RS/6000) family, announced in February 1990, demonstrated huge leaps in technology in the quarter century following the debut of the System/360. Initially available in a series of nine high-performance workstations and servers, even the most powerful model (POWERserver 540) sat beside a desk rather than fill a large room as did the 360. The 540 processed 41 million instructions per second, making it five to 50 times more powerful than the most powerful of the early System/360 models. Its electronic logic circuitry had up to 800,000 transistors per silicon chip (compared with but one transistor per chip on the first 360). Its maximum memory size of 256 megabytes was 256 times more than was offered on the largest of the early 360 line and its internal disk storage capacity of 2.5 gigabytes was 25 times the capacity of the 24-inch diameter, 25-disk module of the IBM 2302 Disk Storage announced with the System/360 in April 1964.

The RS/6000 family achieved its premium performance with three major technical advances: a new superscalar processor capable of executing multiple instructions in a single cycle; the industry's most advanced Reduced Instruction Set Computer (RISC) — pioneered by IBM — floating-point processor for numeric-intensive applications, such as quantitative analysis; and optimized 3-D graphics capabilities for complex applications, such as visualization and mapping.

Q67. What is the IBM **RS/6000 SP** (or SP)?

A67. IBM announced the next generation of its RISC-based high performance parallel computer — the Scalable POWERparallel Systems SP2 — in April 1994. The SP2 represented a new breed of information system which combined the numeric-intensive processing capabilities of scientific and technical computers with the storage and analysis strengths of commercial systems. Based on IBM's RISC System/6000 microprocessor technology and running AIX/6000, IBM's UNIX operating system, the SP2 could scale from four to 128 nodes, and offer significant flexibility in configuring the systems by combining nodes within a frame. Using a POWER2 processor and other options, a customer could obtain twice the processing power of the then current system, eight times greater memory and four times greater bandwidth. A 128-node system had a peak performance of 34 gigaFLOPS (equal to billions of calculations per second), 256 gigabytes (GB) of internal memory and 1,024 GB of internal disk storage.

Q68. What was the **SAGE** computer?

A68. Built by IBM in the 1950s, the Semi-Automatic Ground Environment (SAGE) computers were used in an early U.S. air defense system. When fully deployed in 1963, the system consisted of 27 centers throughout North America, each with a duplexed AN/FSQ-7 computer system containing over 50,000 vacuum tubes, weighing 250 tons and occupying an acre of floor space. SAGE was the first large computer network to provide man-machine interaction in "real time."

Q69. What was the IBM **Series/1**?

A69 IBM introduced the new Series/1 computer in November 1976 for experienced data processing users, i.e., primarily for customers with programming capabilities and a need for multiple systems. It was a general purpose system that offered both communications and sensor-based capabilities, and it enabled users to attach a large number and variety of input and output units, including custom-built devices for special applications.

The Series/1 consisted of 19-inch rack-mountable data processing units. It initially was available with two processors: a Model 3, ranging in memory size from 16K to 64K, and a Model 5, ranging from 16K to 128K. In addition to the processors, the Series/1 also offered at announcement a fixed disk storage unit containing 9.3 million bytes of storable space; a diskette unit able to store either up to 250,000 or up to 500,000 bytes on one- or two-sided diskettes, respectively; a matrix printer which provided 120 character per second bi-directional capability; a display station; a sensor Input/Output unit; an I/O expansion unit to attach additional devices; various communications features; and OEM attachment features. Various processors and peripherals of the Series/1 were withdrawn from marketing between 1983 and 1987.

Q70. What was the **SSEC**?

A70. The IBM Selective Sequence Electronic Calculator (SSEC), dedicated in 1948 by Thomas J. Watson, Sr., at IBM's headquarters at 590 Madison Avenue in New York City, was the first operating computer to combine electronic computation with stored instructions. The SSEC combined the speed of electronic circuits with a storage capacity of 400,000 digits. It had more than 12,000 vacuum tubes and 21,000 electromechanical relays. Data which had to be retrieved quickly were held in electronic circuits while the remainder were stored in relays and as holes in continuous card stock tapes.

Q71. What was the **System/34**?

A71. IBM's General Systems Division announced the System/34 in April 1977 as a low-cost approach to distributive data processing for businesses of all sizes. Centered on the IBM 5340 system unit, the System/34 used as many as eight workstations to provide timely access to current data and offered seven attachments, including the IBM 5251 Display Station. The System/34 was withdrawn in February 1985.

Q72. What is the IBM **System/36**?

A72. When making its May 1983 debut, the System/36 was one of the easiest-to-use general purpose computers ever introduced by IBM. It combined data processing, business color graphics and office management functions in a low-cost computer for first-time and experienced users. The System/36 5360 system unit offered 128,000 to 512,000 characters of main storage and 30 million to 400 million characters of internal disk storage — up to twice the maximum main storage provided by the earlier System/34. Specialized industry terminals which could be used with the System/36 included the IBM 3600 and 4700 finance communication systems, the IBM 5260 retail system, the IBM 5230 data collection system and the IBM 1255 magnetic character reader.

Purchase prices for typical System/36 configurations ranged from $34,000 for a basic system (with 128K characters of main memory, 30 million characters of disk storage, two displays, one printer and the operating system) to $176,000 for a large system (with 512K characters of memory, 400 million characters of disk storage, 26 displays, three printers, a tape drive, the operating system plus languages and utilities). Some models of the System/36 were withdrawn from marketing in September 1986.

Q73. What is the IBM **System/38?**

A73. Under development since 1973 in IBM's General Systems Division laboratory in Rochester, Minn., the System/38 midrange computer was rolled out in October 1978 with many advanced features. These include a single-level store, object-oriented addressing and a high-level machine interface to the user. The System/38 had been designed to facilitate terminal-oriented, transaction-driven operations and to improve programmer productivity.

The basic system included a central processing unit with main storage ranging between 524,288 and 1.572 million positions, 64.5 to 387.1 million positions of disk storage, a console keyboard/display, a diskette magazine drive and work station controllers for up to 40 directly attached IBM 5250 Information Display System devices. Depending on processor model, main storage cycle times were 600 or 1,100 billionths of a second. The purchase price for a complete System/38 at announcement was $91,780. Deliveries of the product began in August 1979, and some models of the System/38 were withdrawn from marketing between March 1982 and June 1986.

Q74. What is the significance of the **System/360** and how does it relate to some other early IBM computers?

A74. The introduction of the IBM System/360 in 1964 marked the birth of a new generation of computers. It represented the culmination of a succession of technological advances and the evolution of the computer from cumbersome electrical relay and vacuum tube machines, through solid state systems with diodes and transistors, to the microelectronics computer circuits used in the IBM System/360.

Generally speaking, vacuum tube machines operated at speeds of thousandths of a second and transistorized solid state machines at millionths of a second. System/360 reached operating speeds measured in billionths of a second.

In the 1950s, computers found their greatest acceptance in such routine accounting applications as payroll and billing. Ten years later, these extremely versatile machines were being used to simulate inventories mathematically, to help set type for magazines and newspapers, to control oil refinery processes, to maintain quality control in automobile assembly, to run machine tools that made other tools, to test rocket engines and to track astronauts in space.

The first general purpose automatic digital computer built by IBM dates back to 1944. It was an electromechanical machine developed in conjunction with Harvard University and was known as the Automatic Sequence Controlled Calculator. It performed additions in one-third of a second and multiplications in six seconds.

In 1948, IBM introduced the Selective Sequence Electronic Calculator which contained 21,400 electrical relays and 12,500 vacuum tubes enabling it to do thousands of calculations in seconds.

The Korean War sped the development of large-scale computers. In 1952, IBM announced its first fully electronic data processing system, the IBM 701. The four years between the Selective Sequence Electronic Calculator and the 701 produced great advances in information technology. The 701 was only one-quarter the size of the SSEC and 25 times faster.

During the next few years, even faster and more versatile vacuum tube machines were developed. The IBM 650 was among the best known, with nearly 2,000 units produced.

Along with the improvement in vacuum tube machines came the introduction of the IBM RAMAC 305 in 1956. This system utilized a vertical stack of 50 aluminum disks coated with iron oxide. It permitted information to be magnetically coded on these revolving disks and entered and retrieved from the storage file on a completely random basis. Prior to this development, information had to be “batched” or sorted into sequence before processing. RAMAC, and developments which evolved from it, greatly increased the scope of data processing.

By the mid-1950s, transistors had begun to replace vacuum tubes in computers. In 1958, IBM announced the 7070 which incorporated solid-state technology offering several advantages over vacuum tube machines. Solid-state devices, such as the transistor, were generally smaller, more reliable and generated less heat than comparable vacuum tube components.

In 1959, IBM introduced two of its most important computers. These were the 1401, widely used for business applications, and the 1620, a small scientific and engineering computer used for such diverse applications as automatic typesetting, highway design and bridge building.

The following year saw the introduction of the large-scale 7000 series, the 1410 and STRETCH, the most powerful scientific computer designed up to that time.

These were the years when the range of systems greatly increased. Much smaller and much larger systems became available. The compact, low-cost 1440, a machine designed for small and medium-sized business, was introduced in 1962. At the other end of the scale, IBM made available the 7094, a powerful system widely used in the aerospace industry for such jobs as simulation of rocket engines and for scientific computing in research laboratories around the world.

The usefulness of computers was greatly expanded by the introduction of IBM data transmission terminals enabling far-flung locations to communicate with a central computer to enter or retrieve information. This ability to communicate with the computer meant that information stored in the system could be automatically updated as transactions occurred and made available upon request to headquarters management as well as field personnel. IBM "Tele-processing" terminals were used, for example, by airlines to provide instant passenger reservation service, banks to update customer files, insurance companies to speed claims processing, factories to report production status and assure quality control, and retailers to speed ordering from wholesalers.

Yet, with all the advances in computer technology, programming and applications in the late-1950s and early-1960s, there were still obstacles to overcome in making maximum use of electronic data processing capabilities.

To provide an expandable system that would serve every data processing need, IBM redesigned its entire product line. The result was the new generation System/360, combining new electronic techniques with advanced computer concepts.

System/360 represented the first basic reorganization of the electronic computer by IBM since the development of the 701 in 1952. More than any other computer development, it tied together the "loose ends" of electronic data processing and offered users a total system capability at a price they could afford.

Specifically, the new system enabled companies to integrate all of their data processing applications into a single management information system. Virtually unlimited storage and instant retrieval capabilities provided management with up-to-the-minute decision-making information.

System/360 included in its central processors 19 combinations of graduated speed and memory capacity. Incorporated with these were more than 40 types of peripheral equipment. Built-in communications capability made the system available to remote locations, regardless of distance.

Until the advent of the System/360, unlimited storage had been expensive and costly. A certain amount of reprogramming had been necessary to use added core units providing additional memory. With System/360, limited storage capacity was no longer an obstacle to the maximum use of a computer. System/360 processors provided a central memory capacity of from 8,000 to 524,000 characters. Additional low-cost storage of up to eight million characters was available with any of the larger configurations.

With System/360, it was no longer necessary to match a user's problem to a specific piece of equipment because of differences in machine design and problem-solving capacity. System/360's units could be combined in an almost infinite variety of ways so that the system was literally tailored to a customer's job.

The built-in communications capability of System/360 allowed the user to greatly increase the scope of computer usefulness. Up to 248 data transmission terminals could communicate with the computer simultaneously — even when it was busy on a batch processing job.

The System/360 also ended the distinction between commercial and scientific computers. Each System/360 processing unit had the ability to process work through small binary, decimal or floating point arithmetic centers. This meant that the same System/360 configuration could handle commercial work, scientific work or a combination of the two, with equal effectiveness.

The launch of the IBM System/360 was a significant event in the history of computing. For IBM, it was a staggering undertaking. The company spent three-quarters of a billion dollars just on engineering, and invested another $4.5 billion on factories, equipment and the rental machines themselves. IBM hired more than 60,000 new employees and opened five major new plants. Thomas J. Watson, Jr., called it "the biggest privately financed commercial project ever undertaken." The timing of the launch, when not all of the new machines had yet gone through rigorous testing, was, said Mr. Watson, "the biggest, riskiest decision I ever made." And when he unveiled the new System/360 on April 7, 1964, he presented it as "the most important product announcement in company history."

Q75. What was the IBM **System/360 Model 40**?

A75. Thomas J. Watson, Jr., said of the System/360 when it as introduced in April 1964 that it was "the most significant product announcement in IBM history." The word "system" was chosen to signify that the new product line was an interchangeable family of processors and peripherals with programming compatibility between all models. The Model 40 had a maximum memory of 256K, a cycle time of 2.5 microseconds and it transferred 16 bits per cycle. It was withdrawn from marketing in October 1977.

Q76. What was the **System/360 Model 75**?

A76. The IBM System/360 Model 75 was introduced in April 1965, with the first delivery, to the NASA Institute of Space Study, following in January 1966.

A powerful processor for integrated data management and processing, the Model 75 had a storage capability of up to 1,048,576 bytes. The machine had a memory cycle time of 750 nanoseconds, and it featured four-way interleaving of memory for faster effective access. (Interleaving is a technique in which the computer's memory is implemented by two or more electronically independent units, any one of which can be accessed while the others are still responding to previous requests.)

The Model 75 was withdrawn from marketing in March 1977. A console from one of the machines has been preserved in the IBM Collection of Historical Computers.

Q77. What was the **System/360 Model 91**?

A77. The IBM System/360 Model 91 was introduced in 1966 as the fastest, most powerful computer then in use. It was specifically designed to handle high-speed data processing for scientific applications such as space exploration, theoretical astronomy, subatomic physics and global weather forecasting. IBM estimated that each day in use, the Model 91 would solve more than 1,000 problems involving about 200 billion calculations. The system's immense computing power resulted from a combination of several key factors, including advanced circuits that switched in billionths of a second, high-density circuit packaging techniques and a high degree of "concurrency," or parallel operations.

To users of the time, the Model 91 was functionally the same as other large-scale System/360s. It ran under Operating System/360 — a powerful programming package of approximately 1.5 million instructions that enabled the system to operate with virtually no manual intervention.

However, the internal organization of the Model 91 was the most advanced of any System/360. Within the central processing unit (CPU), there were five highly autonomous execution units which allowed the machine to overlap operations and process many instructions simultaneously. The five units were processor storage, storage bus control, instruction processor, fixed-point processor and floating-point processor. Not only could these units operate concurrently, they could also perform several functions at the same time. Because of this concurrency, the effective time to execute instructions and process information was reduced significantly.

The Model 91 CPU cycle time (the time it takes to perform a basic processing instruction) was 60 nanoseconds. Its memory cycle time (the time it takes to fetch and store eight bytes of data in parallel) was 780 nanoseconds. A Model 91 installed at the U.S. National Aeronautics & Space Administration (NASA) operated with 2,097,152 bytes of main memory interleaved 16 ways. Model 91s could accommodate up to 6,291,496 bytes of main storage. With a maximum rate of 16.6-million additions a second, NASA's machine had up to 50 times the arithmetic capability of the IBM 7090.

In addition to main memory, NASA's Model 91 could store over 300 million characters in two IBM 2301 drum and IBM 2314 direct access storage units. It also had 12 IBM 2402 magnetic tape units for data analysis applications, such as the processing of meteorological information relayed from satellites. Three IBM 1403 printers gave the system a 3,300-line a minute printing capability. Punched card input/output was provided through an IBM 2540 card read punch.

The console from a Model 91 has been preserved in the IBM Collection of Historical Computers.

Q78. What was the IBM **System/370 Model 145**?

A78. Introduced in September 1970, the Model 145 was the first IBM computer to have a main memory made entirely on monolithic circuits on silicon chips (previous 370 models used magnetic core main memories). Its system storage ranged from 112K to 512K, twice that available with the IBM System/360 Model 40 . It operated at speeds up to five times the Model 40's and up to 11 times the Model 30's. Model 145 users were able to run their System/360 programs with little or no reprogramming. Purchase prices for the Model 145 ranged from about $705,775 to $1,783,000. The Model 145 was withdrawn from marketing in November of 1971.

Q79. What was the IBM **System/370 Model 148**?

A79. The Model 148 of the System/370 computer family was developed and manufactured at IBM's System Products Division facility in Endicott, N.Y., rolled out in June 1976 and first shipped during the first quarter of 1977. It enabled the users of intermediate-sized computers of the day to design larger, more efficient interactive, database and data communications applications. The machine had a maximum main memory of two million characters with internal performance speeds up to 43 percent faster than the earlier Model 145. The Model 148 was withdrawn from marketing in November 1983.

Q80. What was the **Thermal Conduction Module** (TCM)?

A80. The IBM-developed TCM, used in large-scale IBM 3081 and other computers, was the industry's densest and most efficient logic packaging in the 1980s. One module could contain up to 132 circuit chips and had the processing power equivalent to that of a midrange System/370 computer of the 1970s. The water-cooled TCM had the shortest average chip-to-chip communication time of packaging in any general-purpose computer.

Q81. What was the **ThinkPad 701C**?

A81. The IBM ThinkPad 701C was announced in March 1995 with a revolutionary TrackWrite keyboard that formed a comfortable, full-size, 85-key typing surface nearly two inches wider than the unit itself. The ThinkPad could be transformed into a full-function speakerphone, answering machine and fax machine, and, by using built-in infrared, could print documents and send files with no wires or cable connectors. It weighed 4.5 pounds and offered 360-, 540- and 720-million byte hard drives.

Q82. What are some of the milestones in the history of IBM **typewriters**?

A82. Some of the key dates in the history of IBM typewriters are:

1933 IBM acquires the tools, patents and production facilities of Electromatic Typewriters, Inc., of Rochester, N.Y.

1934 IBM invests more than $1 million to redesign the Electromatic Typewriter, improve research facilities and establish service centers.

1935 The IBM Electric Typewriter, Model 01, is introduced. Customer acceptance soon makes it the first successful electric typewriter in the United States.

1941 IBM announces proportional letter spacing. However, the war effort delays product introduction until 1944.

1944 The IBM Electric Executive Typewriter, the first typewriter with proportional letter spacing, is introduced.

1948 The IBM Model A Standard Electric Typewriter gives the typist a new feeling of comfort and control. Carriage return, back space, tabulator and shift are operated with a finger tip touch. A "multiple-copy control" ensures legible carbon copies and stencils.

1951 The IBM Model A Decimal Tabulation Typewriter offers electric tabulation for statistical typing.

1954 IBM introduces the IBM Model B Standard Typewriter and the IBM Model B Executive Typewriter. Both feature cushioned carriage, electric ribbon rewind, changeable typebars and pastel colors.

1957 IBM begins to manufacture typewriter ribbons and carbon paper.

1958 The IBM Electric Typewriter Division celebrates its 25th anniversary and delivers its one-millionth IBM typewriter.

1959 The IBM Model C Typewriter and the IBM Model C Executive Typewriter introduce more productivity enhancements, including personal touch control.

1961 The IBM Selectric Typewriter is unveiled. This product replaces typebars and the moving carriage with a spherical printing element.

1964 To indicate more accurately the scope of its product line, the Electric Typewriter Division changes its name to Office Products Division.

1967 IBM introduces the Model D Executive Typewriter and the IBM Model D Standard Typewriter, the last IBM typebar typewriters.

1968 The IBM Braille Typewriter is the first powered Braille writing machine available for individual use. Its keyboard is almost identical to that of a standard typewriter.

1971 The IBM Selectric II Typewriter lets the typist switch from 10-pitch for correspondence to 12-pitch for business forms and reports. The IBM Tech III Ribbon cartridge permits "clean hands" ribbon replacement.

1973 The IBM Correcting Selectric II Typewriter, with its Lift-off Tape, allows the typist to lift typing errors literally off the paper.

1974 The IBM Memory Typewriter, a desktop typewriter that stores everything typed and allows the operator to recall and revise previously typed material.

1978 The IBM Electronic Typewriter 50 and Electronic Typewriter 60, the first electronic typewriters, introduce a new dimension of features, including automatic error correction, underscoring and centering.

1979 The IBM Electronic Typewriter 75 is introduced. It allows typed material to be stored and recalled from its 7,500-character memory.

1980 The keyboards of the IBM Selectric III and IBM Correcting Selectric III typewriters feature larger, non-glare keys and a lighted margin scale.

1981 The Office Products Division, along with the Data Processing and General Systems Divisions, is consolidated into two new divisions: National Accounts and National Marketing.

1982 The IBM Electronic Typewriter 65 and Electronic Typewriter 85 are introduced. They have automatic right-margin justification, triple pitch and electronic keyboards.

The IBM Personal Typewriter, a compact model for student and home use, is also introduced.

1984 The IBM Selectric System/2000 typewriters, a family of totally electronic machines for a wide range of applications, are announced.

The IBM Quietwriter 7 Typewriter features a new, patented resistive ribbon print technology, plus easy-to-use electronic functions.

The IBM Wheelwriter 3 and Wheelwriter 5 typewriters offer cartridge printwheels along with advanced electronic functions.

1985 The IBM Actionwriter 1 Typewriter offers versatility in a typewriter for schools, small business and the home.

The IBM Wheelwriter System/20 and System/40, and the IBM Quietwriter System/20 and System/40 typewriters offer a new level of typing power and sophistication. Plug-in cartridges like Mailing List, Information Organizer and Spell Check deliver software solutions for a variety of tasks.

1986 The IBM Wheelwriter 6 and Quietwriter 8 typewriters provide advances in speed, power and convenience.

1987 The IBM Personal Typing System combines the simplicity of a typewriter and the flexibility of a word processor with the power of a personal computer.

1988 The largest typewriter announcement in IBM history, featuring the IBM Wheelwriter Series II typewriters and the IBM Personal Wheelwriter Typewriter, provide solutions for virtually every typing application.

1991 Following the sale of IBM's typewriter, keyboard, personal printer and supplies business to Clayton & Dubilier, Inc., a new company — Lexmark International, Inc. — is formed to develop, manufacture and sell such products worldwide.

Public Relations

Q1. What is the origin of the term "**Big Blue**?"

A1. The term "Big Blue" as a reference to IBM did not originate within the company. When the term first began appearing in the press during the early 1980s, IBM employees continued to refer to IBM as they always had — and have since — most typically, "IBM" or "the business" or "the company." Some writers have suggested that the "Big Blue" expression is related to the blue covers on the IBM mainframes and similar products of the 1960s. Of course, "Blue" can now be found in the names of some of IBM's supercomputers, such as Deep Blue, Blue Pacific and Blue Gene.

Research

Q1. What were some of IBM's notable achievements in **computer technology**?

A1. The following chronology covers just some of the significant product technology developed in IBM laboratories and plants during the first four decades of the computer industry. Each of the items represents industry leadership in some form — speed, capacity or other measurement. Many of the items were fundamental inventions that shaped the industry's technological course.

1942 **Vacuum Tube Digital Multiplier** — Experimental machine more than 1,000 faster than earlier electromechanical devices.

1944 **Mark I** (Automatic Sequence Controlled Calculator) — First operating machine to execute long computations automatically. Constructed by IBM in cooperation with Harvard's Dr. Howard Aiken.

1946 **IBM 603 Calculator** — The computer industry's first vacuum tube machine built on a production-line basis.

1948 **"Pluggable Unit"** — The industry's first assemblage of digital electronics replaceable as a unit. Introduced in the mass-produced IBM 604 calculator.

1952 **Tape Drive Vacuum Column** — Invention to buffer magnetic tape between reels to prevent tape breakage at abrupt start and stop. Adopted throughout the industry.

1954 **NORC** (Naval Ordnance Research Calculator) — Most powerful computer in existence for several years.

1954 **Input-Output Channel** — Invention to synchronize the flow of data into and out of the computer while computation progresses. Adopted widely in the industry.

1955 **IBM 704** — The IBM 704 was the first commercially available computer to incorporate indexing and floating point arithmetic as standard features and to base software on them.

1956 **RAMAC** (Random Access Method of Accounting and Control) — Invention of the computer disk file, which became the industry's basic medium for online transaction processing. The IBM 305 RAMAC was the first disk file system.

1957 **IBM 608** — First all-transistor commercial calculator, paving the way for more powerful transistorized computers to follow.

1957 **FORTRAN** (Formula Translation) — The most widely used scientific programming language. First high-level language to gain general industry acceptance.

1959 **Automated Transistor Production** —First fully automated production line for transistors, Poughkeepsie, N.Y.

1959 **Chain/Train Printers** — First commercial “chain” printer, which produced 600 lines per minute from a chain-loop of characters moving at high speed. Led to IBM “train” printer, with type on a steel track in interchangeable-typeface cartridges. Technology adopted by other manufacturers.

1960 **IOCS** (Input-Output Control System) — First computer control program to allow concurrent processing and input-output operations.

1960 **Operating Systems** — Pioneering efforts in the development and implementation of operating systems, including OS/390 in 1964 and the progressively more advanced operating systems developed continuously to the present.

1961 **STRETCH** (for “stretching” technology) — Most powerful computer of its day. Pioneered in advanced systems concepts such as look-ahead, overlapping/pipelining of instructions, and control-program operating systems, as well as introduction of the 8-bit byte and other innovations.

1961 **“Selectric”** — Electric typewriter with “ball” typing element in place of type bars and movable carriage and offering interchangeable type styles. Initially used as a computer terminal.
SABRE (Originally SABER, Semi-Automatic Business Environment Research) — Reservation system developed with American Airlines. The first large high-speed commercial computer/communications network that operated over telephone lines in “real time.”

1962 **Removable Disk Pack** — First interchangeable computer disks, permitting large “shelf” storage of data on disks.

1964 **Hypertape** — Magnetic tape unit with read/write speed of 340,000 characters per second, industry’s fastest for nearly a decade. (IBM had delivered tape units with a speed of 1.1 million characters a second to a U.S. government agency in 1962 but those units were never offered commercially.)

1964 **IBM System/360** — First major computer family with upward and downward compatibility, allowing the use of programming across multiple systems. First computer family to employ widespread use of read-only memory for control and the first family with standard input-output interfaces. Extended the addressing range to 16 million bytes of real main memory.

1964 **Solid Logic Technology** — The industry’s first high-volume, automatic microminiature production of semiconductor circuits, used in the System/360.

1966 One-Transistor Memory Cell — Invention of the dynamic memory cell using one transistor per bit, permitting major increases in memory density. Adopted throughout the industry.

1968 "Cache" Memory — The large, high-speed "cache" or buffer memory in IBM System/360 Model 85 was the first in the industry. It was also the first "monolithic" computer memory of significant size — 16,000 characters.

1970 N-Channel FET Technology — N-Channel Field-Effect Transistors, pioneered by IBM in the 1960s, were introduced in IBM System/370 and adopted by the industry as the basic technology for semiconductor memories.

1970 Relational Data Base Concept — A method of structuring computer data bases that separates data from program code, giving users major advantages in flexibility and ease of use.

1971 Semiconductor Main Memory — IBM System/370 Model 145 had the industry's first main memory made entirely of semiconductor circuits, replacing magnetic cores.

1971 "Thin Film" Recording Head — Development of mass-production "thin film" recording head technology, which later enabled the IBM 3380 disk system to read and write data at three million characters a second, the first commercial unit to achieve such a rate.

1971 "Floppy" Disk — First flexible magnetic disk or diskette, widely adopted for storage in small computer systems.

1973 Magnetic Tape Density — Group Code Recording for magnetic tape, increasing data density almost fourfold — to 6,250 characters per inch — the highest density then available in the industry.

1973 "Winchester" Disk Technology — Improved read/write head design and other improvements introduced with the IBM 3340 "Winchester" disk drive doubled information on the disk surface — to 1.7 million bits per square inch.

1974 Systems Network Architecture — First widely used commercial computer communications subsystems architecture (including Synchronous Data Link Control), permitting distributed network control.

1975 Cryptography — The IBM cryptographic algorithm for protection of transmitted data, adopted as a U.S. government and international standard, can accept 70 quadrillion possible "keys."

1976 Laser Printer — The IBM 3800 was the first machine to combine laser technology and electrophotography. It can print 20,000 lines per minute.

1978 **Electron-Beam Production** — IBM-designed electron-beam machine for interconnecting chip circuits was the first used for volume production of very dense logic circuits.

1979 **64,000-Bit Chip** — IBM was the first to mass produce 64,000-bit memory chips and first to incorporate them into products.

1980 **Densest Circuit Packaging** — Complete logic for the large-scale IBM 3081 was contained in 26 modules on four printed-circuit boards. This packaging of nearly 800,000 circuits was the industry's densest.

1982 **Robotic Control Language** — High-precision, programmable robotic system designed and manufactured by IBM, the IBM 7565, used the most advanced commercially available robotic control language.

1985 **Million-Bit Chip** — A 1-million-bit IBM computer memory chip was the first to be massed-produced for use in computer products.

Since the mid-1980s, of course, IBM has continued to develop and deliver advanced information technology. Here are just some of the most recent examples of IBM's leadership:

- IBM — with nearly 3,000 researchers worldwide — has research laboratories in eight locations in six countries, and has cumulatively produced more research breakthroughs than the rest of the industry combined.
- IBM has employed a total of five Nobel laureates. IBM scientists have been awarded the National Medal of Technology — the highest award for technological innovation in the United States — six times, and the National Medal of Science three times.
- In 1998, for the sixth year in a row, IBM received the most U.S. patents (2,658), 40 percent more than in 1997. IBM now owns more than 30,000 patents worldwide.
- In 1996 IBM hired 10 percent of all of the Ph.Ds in computer science and electrical engineering to enter the U.S. work force.
- In 1997 the IBM "Deep Blue" RS/6000 SP supercomputer redefined the way humanity understands its relationship to machines by besting the greatest grand master in chess history.
- In 1999 IBM announced a $100 million research initiative to build Blue Gene, a supercomputer 500 times more powerful than the world's fastest computers, two million times more powerful than high-end desktop PCs , and capable of more than one quadrillion operations per second (one petaflop).
- IBM storage researchers have pioneered every significant development since they invented magnetic disk storage four decades ago. IBM scientists in 1997 set a new world record in disk drive storage capacity by quadrupling it, breaking the barrier of 10 billion bits of data (10 gigabits) per square inch of disk surface, through IBM's patented giant magneto resistive (GMR) head technology. IBM introduced the world's highest capacity new hard disk drives for both notebook and desktop personal computers. In 1998, IBM introduced the world's smallest and lightest hard disk drive — the 340 MB, 0.7-ounce "microdrive."

- In 1997, IBM introduced a breakthrough in semiconductor technology with the development of smaller, faster, more powerful and less costly integrated circuits using copper "wiring" in place of aluminum — a groundbreaking technological advance that had eluded chip manufacturers for a decade. IBM shipped the industry's first copper chips in 1998.
- In 1998, IBM became the first company to introduce silicon germanium chip-making technology into mainstream manufacturing, offering the first SiGe-based standard products for use in wireless communications products such as cell phones and pagers.
- In 1998, IBM unveiled an experimental microprocessor that operates at 1,000 megahertz, or three times faster than the fastest Intel Pentium chip.
- In 1998, IBM was the largest supplier of custom chips in North America and the second largest in the world. That same year, IBM perfected the Silicon-on-Insulator process to enhance chip speed by up to 35 percent and reduce power requirements by up to 66 percent.
- In 1997, IBM introduced continuous speech recognition for Mandarin, through ViaVoice software, while offering continuous speech products in seven other languages.
- IBM has more than 20 locations in 13 countries with more than 3,000 professionals working on Java technology, including services and products to help customers.

Q2. Have any IBM employees ever won the **Nobel Prize**?

Q2. IBM is fortunate to have had five employees who have won the Nobel Prize. They are: Leo Esaki, of the Thomas J. Watson Research Center in Yorktown Heights, N.Y., in 1973, for work in semiconductors; Gerd Bining and Heinrich Rohrer, of the Zurich Research Center, in 1986, for the scanning tunneling microscope; and Georg Bednorz and Alex Mueller, also of Zurich, in 1987, for research in superconductivity.

Q3. What has IBM contributed to the development of **disk storage technology**?

A3. Some of IBM's key developments in disk storage technology over the years include the following:

1956 IBM introduces the 350 RAMAC, the first computer disk storage system. In less than a second, the 350 RAMAC's "random access" arm retrieves data stored on any of 50 spinning disks. Disk technology later becomes the industry's basic storage medium for online transaction processing.

1962 The IBM 1311 is the first storage unit with removable disks. Each "disk pack" holds more than two million characters of information. Users can easily switch files for different applications.

1965 Database and data communications applications requiring access to large amounts of information — such as airline reservations and online banking transactions — become economically feasible with the IBM 2314 Direct Access Storage facility.

1970 With the IBM 3330, servo feedback technology makes it possible to record data on disks more densely than ever before. Error-correction coding increases the availability of data and the efficiency of the manufacturing process.

1971 IBM introduces the industry's first flexible magnetic disk, or diskette. The "floppy disk" greatly increases the convenience of data handling. It becomes widely used as a basic storage medium for small systems.

1974 The IBM 3340 disk drive introduces an advanced head and disk technology known as "Winchester." The 3340 features a small, lighter read/write head that rides closer to the disk surface — on an air film 18 millionths of an inch thick. The 3340 doubles the information density of IBM disks to nearly 1.7 million bits per square inch.

1980 IBM introduces "thin film" head technology, which enables the 3380 Direct Access Storage Device (DASD) to read and write data at three million characters per second. It is the first commercial unit to achieve such a rate. The thin-film read-write head of the IBM 3380 disk drive "flies" 12 millionths of an inch over the disk surface. This is comparable to a large plane flying 1/20th of an inch over a lake's surface without touching the water.

1981 High-performance "cache" memory is introduced with the 3880 Storage Control. The 3380 moves frequently used data from disk storage into semiconductor storage for high-speed access by the processor. Cache is an advanced, integrated system approach that uses both hardware and software.

1985 The IBM 3380 D/E DASD are introduced. The 3380E offers five gigabytes of storage capacity and is the largest capacity DASD of its time.

1987 Storage subsystem synergy acquires new meaning with the introduction of the triple-capacity 3380 DASD Models J and K and the 3990 Storage Control. The 3380 J/K DASD and the 3990 Models 2 and 3 deliver yet another DASD innovation: four-path data transfer. Extended control unit functions also include DASD fast-write and dual copy.

1989 The IBM 3390 Model 2 increases the capacity of a single DASD box to 22.7 gigabytes (22.7 billion bytes) and the throughput to 40 percent over the IBM 3380K.

1991 The 3390 DASD Model 3 increases the capacity of a single DASD unit to 34 gigabytes and offers up to 180 gigabytes in a 3990/3390 Storage Subsystem.

The new family of rack-mounted, CKD 9340 DASD Subsystems addresses the requirements of intermediate computing environments. The entry-level 9341/9345 connects to a 9221 processor and stores 2-24 gigabytes of information while the 9343/9345 stores 4-48 gigabytes and can take advantage of ESCON.

Since the early-1990s, of course, IBM has continued to develop and deliver advanced storage technology. Here are just some of the most recent examples of IBM's innovations:

- Implementing IBM's patented giant magneto resistive (GMR) head technology, IBM scientists in 1997 set a new world record in disk drive storage capacity by quadrupling the former level and thereby breaking the barrier of 10 billion bits of data (10 gigabits) per square inch of disk surface. IBM also introduced the world's highest capacity new hard disk drives for both notebook and desktop personal computers.
- In 1998 IBM introduced the world's smallest and lightest hard disk drive — the 340 MB, 0.7-ounce "microdrive."

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